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ABSTRACT

This Proceedings volume contains 67 papers. Subjects addressed include: learner curiosity; interpretation construction design; cognitive task analysis; constructivist learning materials and instructional design; learning from video; copyright knowledge levels of media directors; instructional theory for learner control; teacher planning and student achievement; dissemination of training technology; reflective self-regulation; portable usability testing; hypermedia training; computer-mediated communication and group dynamics; technology for teachers; instructional design; digitized speech as feedback; socio-cultural perspective of technology education; teacher decision making concerning content structure; rural training; building community; electronic performance support systems; cultural sharing with the Internet; foreign language instruction; modeling versus coaching; teachers' computer use; closed-captioned television; off-campus agricultural education; fiber-optics telecommunications; profession's knowledge base; animation and visuals; notetaking methods; instructional technology research; intrinsic motivation; graphic organizers; computer conferencing; interactive evaluation model; distance education; closure and group decision making; summary writing; interactive video; National Information Infrastructure and life-long learning; situated instructional design; aural skills instruction; and text elaboration. Previous proceedings' ERIC document (ED) numbers, Research and Theory Division offices, and research papers reviewers are listed, and an AECT membership application is provided. This volume also contains two indices: author and descriptor. (MAS)

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17th ANNUAL

PROCEEDINGS

of
SELECTED
RESEARCH AND DEVELOPMENT
PRESENTATIONS

at the
1995 National Convention
of the
Association for
Educational Communications
and Technology

Sponsored by the
Research and Theory Division
Anaheim, CA

aect

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17th ANNUAL PROCEEDINGS of SELECTED RESEARCH AND DEVELOPMENT PRESENTATIONS

at the 1995 Convention
of the Association for Educational Communications and Technology
Sponsored by the Research and Theory Division
in
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PREFACE

For the seventeenth year, the Research and Theory Division of the Association for Educational Communications and Technology (AECT) is sponsoring the publications of these Proceedings. Papers published in this volume were presented at the national AECT Convention in Anaheim, CA. A limited quantity of this volume were printed and sold. It is also available on microfiche through the Educational Resources Information Clearinghouse (ERIC) system.

REFEREEING PROCESS: All research papers selected for presentation at the AECT convention and included in this Proceedings were subjected to a rigorous blind reviewing process. All references to author were removed from proposals before they were submitted to referees for review. Approximately fifty percent of the manuscripts submitted for consideration were selected for presentation at the Convention and for publication in these Proceedings. The papers contained in this document represent some of the most current thinking in educational communications and technology.

A selected number of development papers, sponsored by the Division for Instructional Development (DID), are included in this Proceedings. The most important instructional development papers were selected by the DID program chairs for publication.

This volume contains two indexes. The first is an author index; the second is a descriptor index. The index for volumes 1-6 (1979-84) is included in the 1986 Proceedings, and the index for volumes 7-10 is in the 1988 Proceedings. After 1988, each volume contains indexes for that year only.

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Title:

Arousing and Sustaining Curiosity: Lessons From The ARCS Model

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Abstract

While the ARCS Model has provided educators with a heuristic approach to generally increasing the motivational appeal of instruction, it may also provide a model for stimulating and sustaining curiosity in particular. Such a model is of great value to educators who are especially concerned with encouraging curiosity as a prime intrinsic motivator for learning and to designers of computer-based systems who wish to incorporate specific strategies for arousing and sustaining the curiosity of users. This conceptual paper explores the construct of curiosity and examines its relationship to all of the ARCS components.

Introduction

"To be uncurious is to have no antennae picking up the future's signals. To be curious is to find that an inquiry into one subject soon has others beckoning" (Weintrub, 1986). The importance of curiosity in motivating scholarship cannot be ignored. Curiosity has been revisited as a topic of interest recently, especially as it relates to the design of interactive computer-based instruction (eg., Rotto, 1994, Arnone & Grabowski, 1994, Arnone & Grabowski, 1992). Research indicates that keeping learners in what Day (1982) calls a "Zone of Curiosity" should result in increased learning and a sense of intrinsic satisfaction. Accomplishing that, of course, is quite a challenge.

Educators and designers often incorporate curiosity-arousing strategies into instruction in a haphazard fashion, when what they really need is a cohesive model with theoretical underpinnings for the selection and implemenation of such strategies. Perhaps a new model should be developed for specifically addressing curiosity, or, is it possible that one already exists which would work well with the construct of curiosity even though it was developed for a more general application to motivational design? Such a model would have great value to educators who are especially concerned with encouraging curiosity as a prime intrinsic motivator for learning and to designers of computer-based systems who wish to incorporate specific strategies for arousing and sustaining the curiosity of users. The purpose of this conceptual paper is to first explore the construct of curiosity and then to examine a leading motivational design model for its appropriateness as a heuristic approach for sustaining curiosity in particular.

Background on Curiosity

The seminal mind in the study of curiosity is Daniel Berlyne. He was thought to have epitomized in his own academic life what is meant by curiosity and intrinsic motivation (Furedy & Furedy, 1981). Berlyne died before his work was complete but his accomplishments were influential in much of the research in curiosity which followed including that of Day (e.g., 1968, 1982) and Maw and Maw (e.g., 1964, 1965, 1966, 1977). The theoretical groundwork Berlyne laid can be seen in much of today's explorations into curiosity both experimentally and conceptually (e.g., Loewenstein, 1994; Arnone & Grabowski, 1994; Rotto, 1994; Arnone & Grabowski, 1992). Other work including that of Beswick (1968) and Langevin (1971) as well as some of the more recent researchers in the field of intrinsic motivation (e.g., Malone, 1981; Csikszentmilhalyi, 1990; Keller, 1987) will be explored in relation to the study of curiosity.

In Berlyne's neurophysiological theory, curiosity is a state of arousal brought about by complex stimuli and uncertainty in the environment, leading to exploratory behavior. He identified two forms of exploratory behavior, diversive exploration and specific exploration, postulating that individuals seeking relief from changelessness or boredom would engage in diversive exploration while those wishing to resolve a conceptual conflict would engage in specific exploration. Berlyne called the motivator for specific exploration "epistemic curiosity," the motivational variable and drive associated with an individual's "quest for knowledge" (Berlyne, 1960). He postulated that the reception of knowledge and its subsequent rehearsal would reduce the drive (1954).

Important to Berlyne's theory is the notion of collative variability which refers to the complexity of a stimulus and the level of difficulty it presents to an individual in comparison to stimuli which are already familiar. Collative properties such as unfamiliarity, novelty, complexity, ambiguity, and incongruity (all conditions of stimulus uncertainty) may increase arousal level and induce curiosity. Presented with a stimulus with a moderate degree of uncertainty, an individual is motivated to make sense of this environment. He thus engages in exploratory behavior (e.g. information seeking/processing/evaluation) generally resolving any conceptual conflict, and returns to what Berlyne refers to as the "tonus level." It is at this moderate, pleasurable level of stimulation that an individual functions most effectively. The optimal level of arousal (where the individual is "curious") is somewhere just above the tonus level. Small increases in stimulation are considered pleasurable because of the resultant return to one's tonus level one experiences once the conflict is resolved.

Day (1982), a research colleague of Berlyne, describes the optimal level of arousal as one in which an individual enters a "Zone of Curiosity" (see Figure 1). With too much uncertainty (caused, for example by too much stimuli or stimuli too high in collative variability), the individual becomes overwhelmed or anxious entering what he refers to as a "Zone of Anxiety." With too little stimulation, on the other hand, the result is disinterest and demotivation often characterized by boredom. In either case, the individual is likely to withdraw from the exploratory behaviors before resolving his conceptual conflict. The degree of importance an individual places on the situation will also play a part in whether an individual's conflict leads to curiosity or to fear and/or anxiety (Berlyne, 1960, Day & Berlyne, 1971).

1).

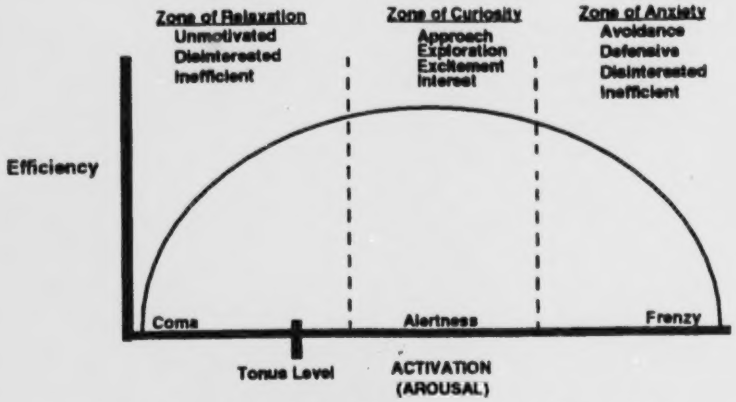

Figure 1: Day's Zone of Curiosity (1982) - The Optimal Level Of Arousal

Both Day and Berlyne (1971) agree that individuals differ in their tolerance and preference for arousal potential, suggesting that curiosity is both a state and a trait variable. What one individual may find optimally arousing, another may find overwhelming or the other extreme, understimulating. Preference for arousal potential can vary from individual to individual and from occasion to occasion. "How much arousal potential of a particular kind an individual will tolerate depends not only on the level of arousal tonus but also on how promptly and easily he has been able to assuage the arousal induced by similar conditions in the past" (Berlyne, 1960, p. 212). Berlyne maintains that "The teacher must, therefore, not only be astute in manipulating the environment but must also be aware of individual differences in tolerance for arousal change" (p. 328).

Building on Berlyne's distinction between specific and diversive exploration, Day developed and validated tests of specific and diversive curiosity. His Test of Specific Curiosity was a 36-item measure which he administered to children in a number of studies (e.g., Day, 1968). He decided, however, that the scale was too brief and narrow and eventually developed the more comprehensive and much used Ontario Test of Intrinsic Motivation (OTIM) (1968).

Maw and Maw (1964) operationalized a definition of curiosity as it relates to elementary school children building on the work of Berlyne. Maw and Maw asserted that ". . . curiosity is demonstrated by an elementary school child when he:

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1. reacts positively to new, strange, incongruous, or mysterious elements in his environment by moving toward them, by exploring, or by manipulating them
2. exhibits a need or a desire to know more about himself and/or his environment
3. scans his surroundings seeking new experiences
4. persists in examining and exploring stimuli in order to know more about them" (p. 31).

It should be noted that their definition included both diversive and specific curiosity with #1, #2, and #4 relating to specific curiosity and #3 relating to diversive curiosity. Day also used their operationalized definition in devising his Test of Specific Curiosity but since he was primarily investigating specific curiosity, he eliminated #3. Maw and Maw's definition of curiosity has proved useful over the years and is frequently used even in recent curiosity studies (e.g., Alberti & Witryol, 1994).

Maw and Maw conducted many studies in their development of pyschometric measures for trait curiosity. They tested the validity of their measures by first establishing criterion groups of high and low curiosity children and then testing whether the measures of curiosity they developed discriminated between the two groups. The means used to establish these groups included teacher judgements, peer judgements, and self judgements of curiosity. The authors found that teacher and peer judgements were not significantly affected by factors such as popularity, race, or sex. Intelligence had to be statistically controlled, however, as both teacher and peer judgements were significantly related to intelligence. When the children in the tentative criterion groups were investigated in terms of their self-judgements of curiosity, it was found that overall the children in the higher curiosity group rated themselves higher in curiosity than those in the low group. The difference between the means was significant at $p = .005$. Maw and Maw used these groups to validate items for their various measures, one of which was the Which To Discuss Test. This particular measure also had fairly high reliability using Cronbach's alpha as a measure of internal consistency, $r = .90$. It has been utilized in numerous studies (e.g. Silverstein, Pearson, Dunnick & Ford, 1981; Beer, 1986; Beer & Beer, 1986, Arnone & Grabowski, 1992; Kerr & Beer, 1992; Arnone & Grabowski, 1994).

Maw and Maw also used question-asking behavior as a measure of curiosity. In one study, children were presented with pictures such as an odd animal, for example, and were then instructed to ask as many questions as they could think of about the pictures. It was found that children who had been previously identified as high curious asked more questions and had more independent ideas than low curious children (1964). A number of other researchers have developed measures of curiosity including Penny and McCann (1964), Naylor's state and trait measures (1981), Vidler and Rawan's Academic Curiosity Scale (1974, 1975), Langevin's Experiential Curiosity Measures (1971), and so on.

While Day, Maw and Maw, and many researchers have subscribed to the basic tenets put forth in Berlyne's theory, not everyone agreed with his theoretical explanation of curiosity. For example, Beswick (1968) proposed a cognitive process theory of curiosity in which an individual receives input (signals) which is taken into his cognitive map or category system (representing all previous experience and learning), and then is coded for meaning. If the individual experiences difficulty in the coding operation, he would engage in assimilation (to modify the signal) and/or accommodation (to modify the category system). Accommodation, then, represents new learning. Beswick asserts that individual differences in curiosity are a function of category system characteristics and differences in one's coding operation as they relate to a conceptual conflict. He states that different people will have different probabilites of coding difficulties depending on the particular situation. One uses different "strategies" for dealing with uncertainty. Curiosity, then, is a preferred cognitive strategy. Highly curious individuals have an "acquired predisposition to increase, prolong, and resolve conceptual conflicts" (p.). According to Beswick, a highly curious person expects a pleasurable integration of the signal with his or her category system and finds this preferred cognitive strategy to be intrinsically rewarding. Still, Beswick uses many of the same concepts as Berlyne and others such as uncertainty, conflict, arousal, and "pleasurable" (in reference to integration in Beswick's theory and stimulation in Berlyne's theory) to explain curiosity.

H. Carl Haywood also took exception to Day's reliance on explaining motivation only in terms of tension-reduction, suggesting that explanations for motivation may also be inherent in information processing (1968). Malone (1981) argues that it is the kind of complexity or incongruity of the information rather than the amount that is motivating and that there is some optimal level of information complexity that can be tolerated. Steers & Porter (1987) state that central to an explanation of arousal "is the idea that the individual cognitively processes and evaluates a lot of information and that motivation is linked strongly to this information processing activity" (p. 33). Olson, Camp, and Fuller (1984) found a strong positive correlation between "need for cognition," defined as the dispositional tendency to engage in and enjoy thinking (p. 71) and curiosity. Most recently, Alberti and Witryol (1994) have argued that cognitive development is enhanced by curiosity and exploration because they expose a person to a "greater variety of experiences in which learning can occur" (p. 129).

Given that there is a cognitive component to curiosity, the importance of information seeking, processing, and evaluation behaviors must be considered. Without sufficient and/or relevant information, the individual will likely have great difficulty in resolving the cognitive conflict the situation presents, thereby experiencing a dramatic decrease in or even extinction of curiosity.

Consider this example. Sarah's curiosity is piqued when her teacher presents a lesson on the rainforests of South America, leaving several unanswered questions at the conclusion of the class (but promising answers the following day). Immediately following the lesson, Sarah goes to the school library media center and peruses the online catalog for materials on this topic. When she finds none, she is highly disappointed, abruptly ends her search, and returns to her classroom unsatisfied. Only if she persists (e.g. going to another library) or there is an external intervention (e.g. the librarian assists her), might her curiosity be rejuvenated to its former level. Her persistence may have been tempered by another factor, importance of the information. Since Sarah had been told that the answers to these questions would be provided the next day, it was likely not as important as it would have been if the questions were not soon going to be addressed. Importance is addressed by the following theorist.

Lanzetta (1968) states that both uncertainty and importance contribute "to the magnitude of conflict and thus to the strength of the motive to search for information" (p.), what he calls the "motivation to acquire information" (p.). As such, uncertainty reduction is the reinforcement for information searching and a preference for sources of information of high uncertainty reduction potential. The motive to reduce uncertainty was also related to curiosity in one of Kagan's (1972) four basic human motives.

Malone (1981) differentiates between sensory curiosity and cognitive curiosity, terms somewhat analogous to Berlyne's perceptual and epistemic curiosity. Sensory curiosity involves enriched learning environments (e.g. animations, brightly-colored illustrations, music) that provide sensual stimulation; where, cognitive curiosity is stimulated when a learner's environment is incomplete, inconsistent, and unparsimonious, motivating him to learn more in order to improve his "cognitive structure" (p. 363). Malone recommends providing informative feedback as a means of helping a cognitively curious learner.

Loewenstein (1994) also argues the importance of feedback in his recently developed "information-gap" theory of specific epistemic curiosity. He acknowledges the works of earlier theorists in the field in the development of his own theory. Curiosity, according to Loewenstein, is a feeling of deprivation which occurs as an individual recognizes a gap in his/her knowledge and is motivated to seek the information that will ameliorate the feeling of deprivation. The information gap is effectively the difference between "what one knows and what one wants to know" (p. 87). He also proposed that as a person's knowledge of a particular domain increases, his/her awareness of information gaps in that knowledge will also increase, thus setting up a necessary condition for curiosity to occur. In this perspective, a person would be predicted to experience "a sudden increase in curiosity when the individual becomes focused on the missing information and then a more gradual increase as he or she approaches the goal of closing the information gap" (p. 89). Relating all this back to feedback, Loewenstein asserts that one must have an *awareness* of an information gap to experience curiosity and that accuracy feedback is one way of helping a person understand what he/she does not know. In the absence of feedback, and with an unrealistic view of one's knowledge (i.e., an individual thinks he/she knows more about a topic that he/she actually does), curiosity for the topic may be decreased or eliminated.

Whether one takes Berlyne and Day's more neurophysiological view, Beswick and others' more cognitive view, Malone's dualistic view, or our more integrative view that recognizes the importance of both neurophysiological and cognitive factors for the explanation of curiosity, it appears that the amount of uncertainty involved and one's personal tolerance for (or strategies for dealing with) a curiosity- arousing situation will affect an individual's response to the source of stimulation (arousal), input (signals), and so on.

Although it is often presumed that intelligence and curiosity go together, most of the studies reviewed showed low or nonsignificant correlations between curiosity and IQ. Langevin overall found IQ to be distinct from curiosity with the exception of the Teacher Rating Test which had significant correlations with the Otis Intelligence Test and the Raven ($r = .3524$, $r = .3263$ respectively, $p = .01$). Day and Berlyne (1971) issue a caution about teacher judgements. Even if provided with a list of behaviors that represent curiosity, there is still a tendency to judge the highest ability students as the most curious. This was shown in a study which found that teacher ratings of curiosity related to achievement scores but not to a measure of novelty used to assess curiosity in third and fifth grade children (Alberti & Witryol, 1994).

In a study involving subjects in grades 7, 8, and 9, Day (1968) predicted that a measure of specific curiosity which measured the subject's intent to approach high levels of visual complexity and to withdraw from low levels of visual stimulation would not correlate with IQ; he found no significance (r = .01) as expected. In another of his experiments on specific curiosity (1968), 429 subjects in grades 7, 8, and 9 from the same school system participated in a study in which he administered his Test of Specific Curiosity and again found no significance in the correlation between his measure and IQ (r = .01).

No significant differences in IQ level between high and low curious subjects were found in a study by Maw and Maw (1965) in which differences in preferences for investigatory activities between high and low curious children were investigated. A study by Henderson and Gold (1983) also lent support for curiosity as being distinct from intellectual power. Henderson and Wilson (1991) failed to support a relationship between measures of curiosity and intelligence in preschool children. They offered one possible explanation that perhaps the relation between these constructs was not concurrent but rather predictive. To test this developmental view, they called for longitudinal studies that "investigate the ability of individual differences in curiosity at time 1 to predict changes in acquisition of knowledge (e.g., intelligence or achievement) from time 1 to time 2" (p. 173).

Alberti and Witryol's (1994) study of curiosity and cognitive ability, based on a similar view that curiosity enhances cognitive development, did, however, show an overall significant positive correlation between a curiosity measure (preference for short-term novelty) and standardized achievement measures in their sample of elementary school aged children. If there is such a relationship between curiosity and cognitive development, then there is good reason to encourage curiosity at home and in school.

One problem with the study of curiosity is that there doesn't appear to be any one "C" (curiosity) factor that we can feel comfortable about saying encompasses the construct entirely. In fact, curiosity seems so multidimensional that it should not even be considered a unitary construct. Yet it is often treated as such, especially in studies where curiosity is only an ancillary variable. Langevin (1971) compared a number of curiosity measures and two intelligence measures and found that while most of the measures were distinct from intelligence measures, several were also somewhat distinct from each other indicating that perhaps their validity should be addressed. Henderson and Wilson (1991) encountered a similar problem when their measures of curiosity did not correlate significantly with each other. They suggested that the curiosity measures may not have been adequate indicators of curiosity, or again that their measures were testing different things. It is easy to see from just the brief sampling of theoretical and empirical works reviewed that curiosity can be considered both a state and a trait, and specific and diversive. With this in mind, researchers must be cautious not to take for granted a more simplistic, all-encompassing construct called "curiosity," but rather to think of it in more complex terms. Figure 2 attempts to graphically represent the multifaceted nature of curiosity.

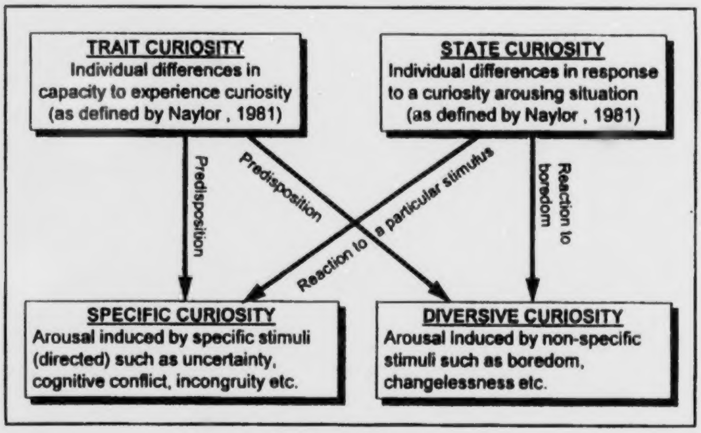
TRAIT CURIOSITY
Individual differences in capacity to experience curiosity (as defined by Naylor, 1981)
STATE CURIOSITY
Individual differences in response to a curiosity arousing situation (as defined by Naylor, 1981)
Predisposition
Predisposition
Reaction to a particular stimulus
Reaction to boredom
SPECIFIC CURIOSITY
Arousal induced by specific stimuli (directed) such as uncertainty, cognitive conflict, incongruity etc.
DIVERSIVE CURIOSITY
Arousal induced by non-specific stimuli such as boredom, changelessness etc.

Figure 2: Multifaceted Nature of Curiosity

Figure 2. The Multifaceted Nature of Curiosity

Several writers and researchers (e.g., Rotto, 1994; Rezabek, 1994) have also begun to explore the Flow Theory of Csikszentmihalyi (1990) and its relationship to motivation and curiosity. Flow is described as a state of intense intrinisic motivation, a natural high such as what athletes describe when they are intensely engaged in their sport. It is an "optimal experience" characterized by clear goals and feedback, challenges that are matched to skills, a merging of action and awareness, highly focused concentration, a sense of potential control, an altered perception of time, a sense of growth, and the engagement in an action simply for its own sake (Csikszentmihalyi, 1983). Flow can occur during work activities or leisure activities but Csikszentmihalyi reports its occurence more often during work activities than leisure activities although individuals are more motivated during leisure activities (Csikszentmihalyi & LeFevre, 1989). Flow experiences can happen at home, in conjunction with hobbies, sports, and even during more passive activities -- anytime when challenges and skills are approximately equal.

Could what Csikszentmihalyi calls optimal challenge resemble what Berlyne and others have referred to as the optimal level of arousal necessary for curiosity to be sustained? It would seem that at least some aspects of sustaining a state of curiosity would resemble those in a flow state. However, the construct of curiosity, at least epistemic curiosity, involves some kind of conceptual conflict which must be resolved. In flow, while challenge is necessary, conflict is not. Malone (1981) explains that Csikszentmihalyi focuses on the role of challenge in intrinsic motivation but omits mentioning the importance of curiosity because he is not dealing specifically with a learning context.

John Keller's work (e.g. 1979; 1983) has focused on the importance of motivation in instruction and learning. Keller has developed the ARCS (Attention, Relevance, Confidence, Satisfaction) Model of Motivational Design, based largely on Porter and Lawler's (1968) Expectancy-Value Theory, but also incorporating a number of other motivational variables (e.g. locus of control, need for achievement). Keller (1979) cites the importance of curiosity as a motive to reduce uncertainty, "a person's responsiveness to incongruity and uncertainty" (p. 31) and uses it as the primary theoretical basis of the attention component of his model. He recommends a judicious application of instructional strategies that arouse, maintain, and/or increase curiosity (e.g. presenting novel, incongruous, or paradoxical events, posing a perplexing problem, and using analogies).

The ARCS Model and Curiosity: Is There a Fit?

While Keller's model is designed to raise the overall motivational level for instruction (including both intrinsic and extrinsic motivation), each component of the model may contribute to the arousing and sustaining of curiosity. The problem has been that typically curiosity is linked to the attention component, so that parents and teachers sometimes overlook the value of the other components in encouraging curiosity as a prime motivator for learning. In this section, we will attempt to show the "fit" between the ARCS model and both the arousal and sustaining of curiosity.

Let's begin by briefly returning to the theoretical underpinnings of the ARCS Model. As noted earlier, one of the dominant theories upon which the ARCS Model is based is Expectancy-Value (E-V) theory (e.g., Porter & Lawler, 1975). E-V theory posits that motivation occurs as a result of both one's expectancy for success and one's perception that a particular activity will be personally rewarding. Keller makes a direct link between the value dimension and research in the area of curiosity (1983). Expectancy for success factors into curiosity as well. For example, Loewenstein's Information Gap Theory holds that "people will be more curious to know something if they think it is knowable" (p.93). Keller states that the value dimension is most closely related to his attention and relevance components while the expectancy dimension of E-V theory is most closely alligned with the confidence and satisfaction components (Keller, 1979). This distinction was supported in a recent study by Small and Gluck (1994).

Although curiosity is primarily associated with the attention component, we assert that every component of ARCS (i.e., attention, relevance, confidence and satisfaction potential) contributes to an explanation of the successful arousal and sustaining of curiosity and an eventual resolution of its underlying conflict. In order to keep an individual in Day's (1982) Zone of Curiosity, it may be necessary to incorporate all of the components into instruction. Since learners bring many individual differences to a learning situation, however, any model is necessarily heuristic as opposed to prescriptive.

Rotto (1994) notes, if the curiosity-arousing situation does not "show promise of being useful, moderately non-threatening, and of being rewarding, we will not be led to explore it in any extended way (p. 6)." This would seem to be true if you think of the state of curiosity as being one in which the individual is at an optimal level of arousal, thereby focusing all his attention toward a particular stimulus. The individual must then experience a desire to resolve a conflict (i.e., the conceptual conflict has some relevance to him), be confident that the conceptual conflict can be resolved and that he/she is capable of resolving it, and have a sense that there is potential for satisfication once the conflict is resolved. For curiosity to be sustained (e.g., the exploratory behaviors persist for long periods of time, and/or the learner experiences repeated occurrences of curiosity within the same teaching/learning episode), then, in addition to attention, there must be relevance, confidence, and satisfaction potential. Integrating Day's (1982) and others theoretical view of curiosity, and Keller's ARCS model, Figure 3 attempts to depict the relationship between the ARCS components and arousing and sustaining curiosity.

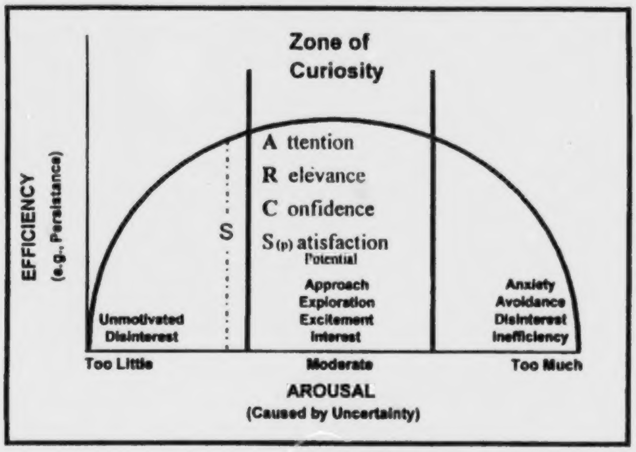
Zone of Curiosity
A ttention
R elevance
C onfidence
S(p) atisfaction
Potential
S
EFFICIENCY
(e.g., Persistance)
Unmotivated
Disinterest
Approach
Exploration
Excitement
Interest
Anxiety
Avoidance
Disinterest
Inefficiency
Too Little
Moderate
Too Much
AROUSAL
(Caused by Uncertainty)

Figure 3: Adapted from Day (1982)

Figure 3. Adapted from Day (1982)

Curiosity and Attention. Keller (e.g., 1983) describes a relationship between curiosity and the attention component of his model and suggests a number of strategies for gaining and sustaining attention, such as novelty, surprise, incongruity, ambiguity, etc. These same elements have been described in prior curiosity research as properties of collative variability which are representative of uncertainty and useful in inducing curiosity.

Consider the following example. At Miami's Central High School, Ms. Adams, the chemistry teacher, describes how, according to scientific law, the combination of chemical X and chemical Y should turn the litmus paper blue. Later in chemistry lab, Jim conducts an experiment in which he mixes the two chemicals and inserts litmus paper, but upon withdrawing the paper finds that it has turned red. He is surprised by this unexpected outcome, his curiosity is aroused and he turns his attention to searching for the cause.

Figure 4 builds on Day's Zone of Curiosity and represents a situation in which there is no learner attention. Learner attention is a prerequisite to the establishment of relevance, building of confidence, and recognition of satisfaction potential. When attention is absent, the learner (indicated by an X) *never* enters the zone of curiosity, remaining instead in a zone of disinterest.

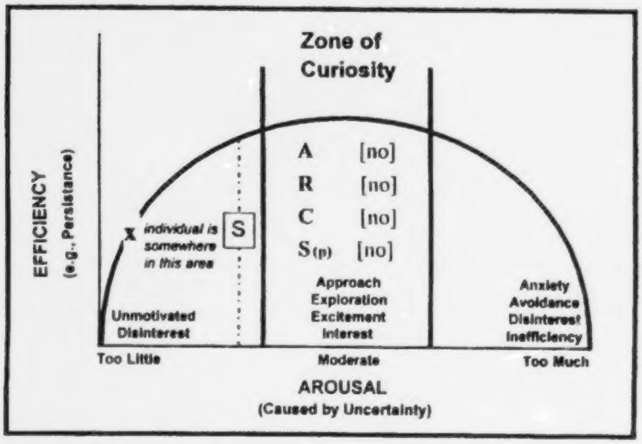

Figure 4 : No A (curiosity is not aroused), therefore no chance for R, C, or $S_{(p)}$

Figure 4. Situation Lacking Attention Prohibits Relevance, Confidence, and Satisfaction Potential

Curiosity and Relevance. To keep one in a zone of curiosity (at least when discussing state epistemic curiosity), the second ARCS component, relevance, also comes into play. Perceived value (personal relevance) has been shown to be significantly related to the decision to seek additional knowledge in young and middle-aged adults (Camp, Rodrigue, & Olson, 1984). Loewenstein (1994) acknowledges the role preexisting interests play in elevating one's informational reference point which is synonomous with what a person wants to know. Curiosity occurs when one's "informational reference point in a particular domain becomes elevated above one's current level of knowledge" (p. 89). This suggests that educators increase their chances of stimulating curiosity when they give learners choices (reflecting personal interests) which is a recommended relevance strategy in the ARCS Model. Loewenstein's information-gap perspective of curiosity also predicts that curiosity increases as knowledge of a domain increases given that the objective *value* of the missing information remains the same (p.90). It would seem, then, that relevance can be increased by introducing a curiosity-arousing situation which has at least some familiarity to the learner (that is, the learner already has some knowledge about it). The relevance component of the ARCS Model reflects the importance of familiarity and tying instruction to the learner's experiences.

Relevance may even occur naturally (that is, without any external intervention) as awareness of a gap in one's knowledge becomes apparent. Also, in line with Beswick's (1968) cognitive processing model, any stimulus event or "signal" that is at odds with one's existing "cognitive map" is likely to automatically become more relevant. Considering this, attention and relevance go hand in hand. If an attention strategy such as introducing incongruity is used for a particular instructional purpose, it should, in addition to *arousing* curiosity, lead to increasing the importance to the learner of continuing her search until there is no longer incongruity, thus *sustaining* curiosity. This is consistent with Lanzetta's (1968) emphasis on uncertainty (attention-related) and importance (relevance-related) as critical to the motivation to acquire information.

Returning to our example, Jim continues to explore the possible factors that contributed to the result of his experiment because he feels a need to close his information gap and explain (and potentially correct) the unexpected outcome. Therefore, even when a learner's attention is aroused and he feels confident that he can resolve the uncertainty or incongruity (and thereby satisfy his curiosity), if relevance is lacking then curiosity, which is intrinsic in nature, cannot be sustained (see Figure 5). As a result, the learner perceives no potential for satisfaction and becomes unmotivated and disinterested. Persistence in the activity will likely be prolonged only if it is connected to some external motivation, such as a raise in pay or a high grade, a motive which no longer can be considered curiosity.

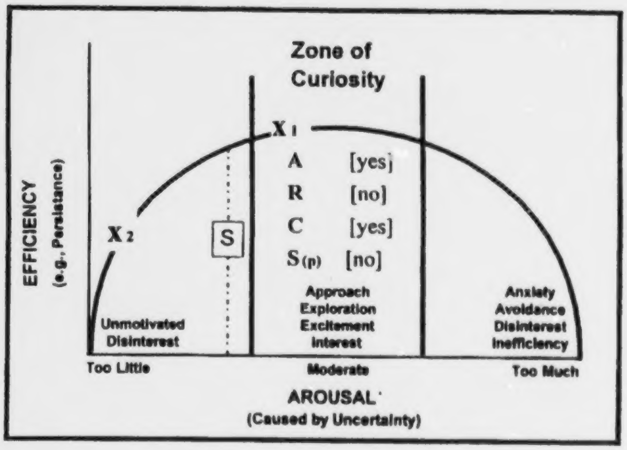

Figure 5: A, C, but no R and hence no $S_{(p)}$

Figure 5. Attention and Confidence Without Relevance Results in Lack of Satisfaction Potential.

Curiosity and Confidence. Even if a learner finds particular instructional materials or events initially arousing and somewhat relevant, it is unlikely that curiosity will be sustained without some confidence that she will be able to resolve the conflict. If, on the other hand, the learner feels confidence that she can resolve a particular conceptual conflict, she is likely to stay in a zone of curiosity, manipulating or exploring the environment. For example, dealing with ambiguity entails seeking needed information through exploratory and epistemic behavior, but as Berlyne (1960) notes "this means that the conflict must be faced and born for a while" (p.216). A study Berlyne described in his famous book "Conflict, Arousal, and Curiosity" found a positive correlation between tolerance for ambiguity and self-confidence. Tolerance for complexity could also play a part in whether curiosity is sustained or extinguished. Yerkes & Dodson (1908) found that if a task is too difficult, motivation decreases. If a conceptual conflict proves too complex or difficult, one could likewise expect curiosity to decrease. The confidence component of the ARCS Model suggests strategies for dealing with difficulty level of materials which could be modified to address curiosity in particular.

Anxiety may play a part in undermining one's confidence and in cutting short one's time in the zone of curiosity to which Day (1982) refers. Anxiety reduction is also addressed under this component of Keller's Model with one suggestion being that confirmational and corrective feedback will assist in reducing anxiety; this would result in extending the time one is willing to spend in the zone of curiosity. The use of informative feedback has been associated with the reinforcement of curiosity (Malone, 1981). If, in our example, Ms. Adams provides Jim with some verbal cues about his perplexing problem and suggests additional books and other information resources, Jim may feel more confident that he will resolve his curious situation.

While flow theory addresses intrinsic motivation and not specifically curiosity, it could be hypothesized that, in some cases, a sustained state of curiosity may evolve into a "flow" state in the process of resolving a conceptual conflict. As our friend Jim delves into the various information resources, he may become so absorbed that he experiences flow. Challenges and skills are important to flow theory, challenge and curiosity have been linked (Malone, 1981), and they both seem to be related to the concept of self-confidence. In the confidence component of the ARCS Model, challenge levels (e.g., deciding on an appropriate challenge level for a particular audience) are addressed, as well as building feelings of competence and positive expectations for success.

So, if a situation occurs in which both attention and relevance are present but the learner believes the curiosity-arousing situation is too difficult or complex, the learner may lack confidence to continue. Without confidence, and in the presence of a stimulus with a high degree of uncertainty, the individual will likely fall back into a zone of disinterest or fall forward in a zone of anxiety, eventually withdrawing from the exploratory behaviors as the curiosity quickly diminishes. In this scenario, satisfaction potential disappears (see Figure 6).

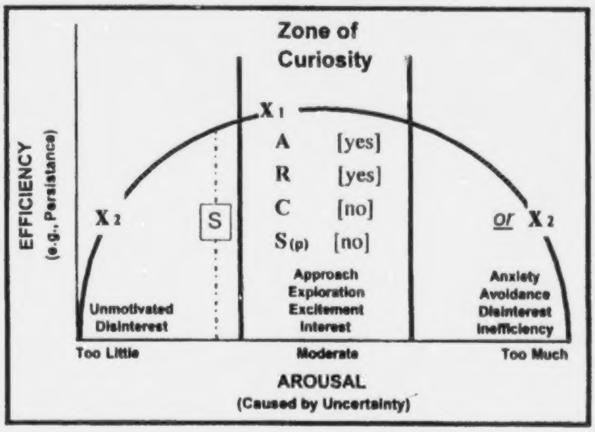
Zone of Curiosity
EFFICIENCY (e.g., Persistance)
X1
A [yes]
R [yes]
C [no]
S(p) [no]
X2
S
or X2
Unmotivated Disinterest
Approach Exploration Excitement Interest
Anxiety Avoidance Disinterest Inefficiency
Too Little
Moderate
Too Much
AROUSAL (Caused by Uncertainty)

Figure 6: A, R, but no C, $S_{(p)}$

Figure 6. Attention and Relevance Present But No Confidence And Therefore No Satisfaction Potential.

Curiosity and Satisfaction Potential. Satisfaction potential must be high in order for an individual to remain in a curiosity state. If there is only a slim chance for satisfying one's curiosity, it is unlikely that an individual will expose himself to a curiosity inducing situation (Loewenstein, 1994). Since the curiosity-invoking situation produces an aversive state of tension and uncertainty, the potential for satisfaction resulting from its reduction is correspondingly high. According to Berlyne and Day, upon the actual resolution of a curiosity arousing situation the individual returns to his/her tonus level. Loewenstein writes: "The pleasure derived from satisfying curiosity provides a simple explanation for voluntary curiosity seeking. It is perfectly sensible for people to expose themselves to curiosity-inducing situations if the expected incremental pleasure from obtaining the information compensates for the aversiveness of the curiosity itself" (p.90). (This statement can also be related to the confidence component of the ARCS Model that addresses positive expectations for success as a motivator.) The fit with Keller's Model comes as he addresses intrinsic reinforcement under the satisfaction component. For Jim, then, an understanding of the cause of his experimental outcome has the potential for satisfaction (in keeping with several theoretical approaches) in the form of tension reduction, cognitive integration or closing his information gap, intrinsic feelings of accomplishment and competence, and praise from his teacher as an extrinsic bonus which is of less interest to us.

Only after the individual resolves the curiosity-invoking conflict will actual satisfaction occur. In our example, Jim experiences satisfaction when he reads in one of his sources that if even a small amount of chemical Z is added to chemicals X and Y, a different chemical reaction will occur. Jim remembers that during the last lab session, he had neglected to clean his beaker which had contained chemical Z. As a result, the beaker contained residue of chemical Z which, when mixed with the two chemicals in the experiment, caused the litmus paper to turn red rather than blue. After thoroughly cleaning the beaker, Jim tries the experiment again and obtains the expected result.

Figure 7 depicts the presence of all ARCS components. The result would be a sustaining of curiosity followed by a return to the pleasurable tonus level (equated to the satisfaction component of ARCS) once uncertainty is reduced (e.g., by resolving a conceptual conflict).

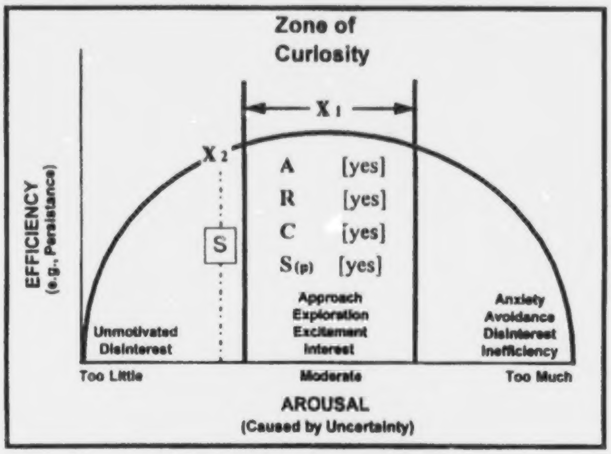
Zone of Curiosity
X1
X2
A [yes]
R [yes]
C [yes]
S(p) [yes]
S
EFFICIENCY (e.g., Persistance)
Unmotivated Disinterest
Approach Exploration Excitement Interest
Anxiety Avoidance Disinterest Inefficiency
Too Little
Moderate
Too Much
AROUSAL (Caused by Uncertainty)

Figure 7: A, R, C, $S_{(p)}$ are all present

Figure 7. All ARCS Components Present, Satisfaction Occurs.

Design Recommendations

In this section of our paper, we include recommendations for arousing and sustaining curiosity in learning contexts using the ARCS Model of Motivational Design. For example, strategies in keeping with the first two components of ARCS, attention and relevance, can be used to introduce a conceptual conflict that has at least some relevance (any stimulus which differs from schema already accepted by the individual may suddenly become more relevant as he/she struggles to integrate it into existing schema). The third component comes into play as we design strategies which give the learner the confidence that he or she will be capable of resolving whatever conceptual conflict the instance of curiosity has engendered. Satisfaction potential in the context of curiosity refers to an individual's perceptions about the potential intrinsic rewards that will result from resolving the curiosity-invoking situation. Satisfaction, the last ARCS component, occurs when, after sufficient exploration (while in the zone of curiosity), one resolves the conceptual conflict and returns to the pleasurable tonus level. Satisfaction can take many forms including external rewards, but when stimulating curiosity is the motivational goal, it is in intrinsic satisfaction as a natural by-product of a curiosity-arousing situation that we are particularly interested.

The following section includes a number of curiosity-arousing and maintaining strategies related to each of the ARCS components that may be incorporated into an instructional design.

ARCS COMPONENTS	RECOMMENDATIONS FOR AROUSING AND SUSTAINING CURIOSITY
ATTENTION	•Use collative properties such as complexity, novelty, incongruity, contradiction, and ambiguity to provoke a cognitive conflict. •Create an atmosphere where learners feel comfortable about raising questions and where they can test their own hypotheses through discussion or brainstorming. •Be aware of the degree of stimulation which is entered into the learning situation. Anxiety may be induced if the stimulus is too complex, too uncertain, too novel. Boredom may result if there is too little stimulation. •Be senstive to individual differences in tolerance for curiosity arousal (notice which individuals approach new and/or different stimuli and which display avoidance behaviors). This should help you in determining how much uncertainty to introduce when attempting to arouse curiosity. •Help learners become aware of their information gaps in a particular topic area. •Minimize distractions that may have the effect of eliminating curiosity once aroused.
RELEVANCE	•Model curious behaviors to increase learners' perceptions of the importance of curiosity. •Allow students to become engaged and curious about topics or interests in which they already have some knowledge. •Have learners think about how they might feel once they have resolved the conceptual conflict. •Make statements that help learners to see the potential value in persisting in a curiosity-arousing situation until the necessary information has been found. Have them set their own personal information goals. •Provide opportunities for learners to choose alternative strategies for exploring curiosity-stimulating situations.

CONFIDENCE	•Make the challenge or conflict in line with learners' skills and abilities and at the appropriate level of complexity. •Provide informative feedback that will help learners see a realistic picture of their information gaps and reinforce their curiosity (reducing possible anxiety). •Help learners have positive expectations for success based on having clear goals (e.g., learner has a plan for seeking the necessary information to, as Loewenstein (1994) would say, close his/her information gap). •Encourage exploration and give learners opportunities to explore curiosity arousing situations in their own ways. •Support information-seeking activities. •Allow time for learners to persist in their explorations or information seeking.
SATISFACTION	*While satisfaction is a natural by-product of a curiosity-arousing situation once the conceptual conflict has been resolved, there are a number of strategies taken from Keller's Model which could provide additional satisfaction while setting the stage for future curiosity behaviors to occur. . .* •Bring attention to the intrinsic enjoyment that learners feel as a result of reducing the uncertainty connected with curiosity. •Be enthusiastic about the learners' accomplishments as they relate to curiosity. •Give learners an opportunity to reflect on their curiosity arousing episodes and their resolution. •Acknowledge any special challenges that may have been encountered in the process of resolving information uncertainty. •Provide the learner with additional materials about related areas of interest. •Inform learners if possible about ways in which they might continue to explore the area which was the source of their recent curiosity. •If one learner has resolved his/her uncertainty before others, allow him/her to provide guidance and informative feedback to others who are not yet there. *(Note the concentration on instrinsic reinforcement as opposed to extrinsic rewards)*

Summary

While the ARCS Model has provided educators with a heuristic approach to generally increasing the motivational appeal of instruction, it may also provide a model for stimulating and sustaining curiosity in particular, certainly an important challenge to today's educators and instructional designers. This paper has reviewed some of the research on curiosity, examined the relationship of curiosity to each of the ARCS components, and provided some ideas for stimulating and sustaining curiosity in learning contexts.

One of the greatest challenges of educators today is fostering intrinsic motivation in learners -- encouraging a love of and desire for lifelong learning. Research that provides a framework for designing instruction that stimulates and sustains curiosity may provide one giant step in that direction.

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Title:

Student Understanding and Learning from an Interpretation Construction Design

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Study is a key concept in making design more fruitful in education. We propose that what students are doing when they construct knowledge is studying. For several years, Teachers College, Columbia University and the Dalton School (an independent school in New York City), have been collaborating on the Dalton Technology Project. The goal of the project is to use networked multimedia workstations to provide Study Support Environments (SSEs). Creating SSEs allows us to create "a place for study in a world of instruction" (McClintock, 1971). The core of study is the hermeneutic activity of constructing interpretations. From this perspective, the basis for cognition is interpretation based on background knowledge and beliefs (Heidegger, 1962; Winograd and Flores, 1986). Thus, the key consideration in designing a SSE is fostering the construction of interpretations based on observations and background contextual information. In this paper, we describe a framework for SSE design and describe its application to a specific SSE created as part of the Dalton Technology Plan. After describing the SSE we report an evaluation that demonstrates its effectiveness.

Interpretation Construction (ICON) Design Model

Much of the effort in the Dalton Technology Project has gone into developing particular study systems for different subject areas, but we have also been working to specify what the appropriate design principles would be for this approach. As reported earlier (Black and McClintock, 1995; Black, McClintock and Hill , 1994) this constructivist design approach seems to be captured by the following seven principles comprising the Interpretation Construction (ICON) design model:

1. **Observation:** Students make observations of authentic artifacts anchored in authentic situations

2. **Interpretation Construction:** Students construct interpretations of observations and construct arguments for the validity of their nterpretations

3. **Contextualization:** Students access background and contextual materials of various sorts to aid interpretation and argumentation

4. **Cognitive Apprenticeship:** Students serve as apprentices to teachers to master observation, interpretation and contextualization

5. **Collaboration:** Students collaborate in observation, interpretation and contextualization

6. **Multiple Interpretations:** Students gain cognitive flexibility by being exposed to multiple interpretations

7. **Multiple Manifestations:** Students gain transferability by seeing multiple manifestations of the same interpretations

Some of these constructive design principles are adaptations from proposals by others. For example, the Cognitive Apprenticeship principle comes from Collins, Brown and Newman (1988), the Multiple Interpretations one from Spiro, Feltovich, Jacobson and Coulson (1992), and the Collaboration one from Johnson, Johnson, Holubec and Roy (1984). The Observation principle is a combination of recommendations by Brown, Collins and Duiguid (1989) and the Cognition and Technology Group at Vanderbilt (1990), but our focus on authentic artifacts is unique. Further, our emphasis on Interpretation Construction, Contextualization, and Multiple Manifestations is distinctive.

An Example SSE

To illustrate the application of this design framework, we describe an SSE program created for the Dalton Technology Plan. Specifically, we describe how these constructive design principles apply to the *Galileo* program used in 11th and 12th grade science (particularly for students not scientifically oriented) at the Dalton School.

In the *Galileo* program, students study astronomy and science in general by using observations of telescopic plates and a computer simulation of the sky to construct and test interpretations of astronomical phenomena. Students examine and make measurements on photographic plates from observatory telescopes and computer simulations of the sky (**Observation**), then relate these analyses to reference materials (**Contextualization**) containing what is know about astronomical objects (i.e., stars, planets, etc.). The teacher initially talks through how he would analyze and interpret examples of such astronomical data (**Cognitive Apprenticeship**) then the students form groups to work on some data (**Collaboration**), while the teacher coaches and advises them as they proceed. The students develop their own hypotheses and test them against the astronomical data (**Interpretation Construction**). Students defend their hypotheses using their analyses and reference materials both within and between the groups, and such argumentation together with background readings exposes them to various ways to interpret the data (**Multiple Interpretations**). As they proceed through the course, the students see how basic principles of astronomy, physics and chemistry can be used to make sense of different sets of astronomical data (**Multiple Manifestations**).

An Evaluation of Generic Skill Learning with the SSE

Since we believe that interpretation is central to cognition and learning, we evaluated whether the *Galileo* program would increase students' interpretation skills. Specifically, we tested whether the students who had been through this program could make observations and interpretations in a completely new area better than students who had not been through the programs. For these studies, we chose an area unlikely to be familiar to precollege students -- namely, cognitive psychology.

In this evaluation study, the 11th and 12th grade students who had been through the *Galileo* program were compared to a comparable group on how well they could interpret and link three related cognitive psychology studies and their underlying principles. The students were given booklets containing descriptions of basic observations made in these three psychology studies together with various informational resources including relevant and irrelevant background material. The students were given three hours to perform the task and write a final report. These reports served as a measure of the students abilities to recognize particular patterns in the data, argue or explain the causes and effects of these patterns, as well as represent the data to support or refute their interpretations.

Method

Participants

The experimental group consisted of 46 11th and 12th grade students at the Dalton School who were at the end of the *Galileo* course. The control group was 33 Dalton 10th and 11th grade students who planned to take the *Galileo* course during the following year.

Materials

The participants were provided with copies of data from three cognitive psychology studies. The participants were told that in all three of the studies they were reading about, the researchers select six students and have them memorize a list of 12 Subject-Verb-Object sentences (propositions). However, the studies differ in the following ways:

> Study One. One full day after remembering the list, participant memory is tested with items on computer screen. the propositions appear in the same form as they were memorized. The computer records how long it take each participant to respond with an affirmative answer.
>
> Study Two. A different set of six students are asked to recall the propositions they memorized a day before; however, this time, they are tested with the passive voice version of the sentences instead of the active voice version they memorized. Once again, the computer records how long it takes each participant to respond with an affirmative answer.
>
> Study Three. Yet another set of six students are asked to recall the propositions they memorized earlier; however, in this study, participants are tested with paraphrases of the sentences

memorized and asked to respond "yes" if the test sentence as essentially the same meaning as the memorized sentence.

Upon reading these three studies and the background materials provided, Dalton students were asked to interpret the data using background materials provided as well as other outside sources. The background readings included both relevant information about information processing systems as well as propositional network theory. Irrelevant information from philosophy was also included as a distractor.

Procedure

Administering the Materials and Collecting Student Reports.

The study was conducted in one 3-hour session. First, the experimenter passed out the assignment booklets and the teacher read the instructions on the first page of the assignment booklet. After the instructions, the students proceeded to work on the assignment in their groups. While doing the assignment the students were free to use any of the resources in the Dalton School building (computers, libraries, etc.) including asking the experimenter clarification and information questions (the same experimenter and teacher conducted all sessions). At the end of the 3-hour period the students handed in their reports and all the work they had done in folders.

Analysis of Student Reports

The file folders from both the *Galileo* and pre-*Galileo* groups were evaluated along the following there dimensions: pattern recognition, explanation and argumentation, and data representation. These dimensions were weighted 2:3:1 based upon levels of difficulty. More specifically, groups could earn up to 20 points for pattern recognition, 30 points for explanation and argumentation, and 10 points for data representation. Extra credit points were awarded for plausible recommendations for follow-up studies on the cognitive psychology principles tested; however, a majority of the students did not address this aspect of the data.

Using our coding system, we were able to weigh answers in terms of difficulty as well as plausibility. the "optimal responses for pattern recognition, explanation and argumentation, and data representation are as follows:

Pattern Recognition

Study One. Students should recognize that the response time increases with the number of propositions per subject. For example, if lawyer has e propositions and doctor has 2 propositions then subjects will take longer to remember a proposition about the lawyer than the doctor. They are also expected to report the means. Partial credit is given for alternative patterns. *Maximum Points: 4.*

Study Two. Students should note that the positive relationship between number of propositions per subject and response time still holds. They should also recognize that study two takes longer than study one. Again, means should be reported and partial credit is given for alternative patterns. *Maximum Points: 7.*

Study Three. Students should recognize that the positive relationship between number of propositions per subject and response time still holds. They should also note that study three takes longer than study one and study two. Ideally, students should note that study three has a steeper climb (i.e., slope) than the other two studies. Means should be reported and partial credit is given for alternative patterns. *Maximum Points: 9.*

Explanation and Argumentation

Study One. In this study, the optimal respones would relate the information processing and/or propositional network theories to the pattern recognized. Partial credit was given for responses favoring individual differences. Testing hypotheses was also credited. Maximum Points: 6.

Study Two. Students were supposed to relate the increase in mean response time to the stage of transforming a proposition from passive to active voice. They should have also noted that it takes time to match the transformed proposition to the database. Again, students were given points for appropriately using information processing theory or propositional network theory to support their hypotheses. Partial credit was given for responses favoring individual differences. Regardless of final outcome, hypothesis testing was also given partial credit. Maximum Points: 12.

Study Three. Students were given credit for discussing how the overall increase in mean response time is due to an increase in search time, which is caused when a synonym for the original proposition is put in the recall test. They also should have noted that the increased time is due to the time required to match the synonym against the database. Students were given credit for using relevant background readings. Partial credit was given for responses favoring individual differences. Students were also given partial credit for reporting their hypothesis test and results. Maximum Points: 12.

Data Representation

Groups were given credit for creating spreadsheets that reported means and/or ratios, bar graphs that appropriately represented the data, propositional network diagrams, and alternative ways of representing the data to support explanations of trends. Ideally students would have been creating graphs that reflected the differences between studies. By plotting these trends, students would have recognized that the intercepts of study one and study three are the same but their slopes are different. Additionally, the intercept of study one and study two are different but their slopes are the same. Representations of these trends were likely to have improved both pattern recognition and argumentation scores. *Maximum Points: 10.*

Results

Table 1 presents the results of the data analyses. As the first column in Table 1 shows, in total the *Galileo* group scored 33% higher than the pre-*Galileo* group (26.1 vs. 19.6 -- out of 60 possible), and this is statistically a very significant difference, $t(77)=4.56$, $p<.001$.

Table 1
Quantitative Analysis of Reports Written by Students in the *Galileo* Group and the Control Group

	Total	**Pattern Recognition**	**Explanation & Argumentation**	**Data Representation**
***Galileo* Group**	**26.1**	**9.8**	**14.2**	**2.1**
Control Group	**19.6**	**7.7**	**11.8**	**0.1**

This significantly superior performance of the *Galileo* group also occurred in all three of the component scores: namely, in Pattern Recognition (9.8 vs. 7.7 -- out of a possible 20), $t(77)= 2.40$, $p<.01$; in Explanation and Argumentation (14.2 vs 11.8 -- out of a possible 30), $t(77)=1.69$, $p<.05$; and particularly in Data Representation where the pre-Galileo control group effectively got 0 (specifically, 0.1) whereas the *Galileo* group got 21% of the possible (2.1 out of 10 possible), $t(77)=6.14$, $p<.001$.

Conclusions

We have proposed an approach to constructivist design (ICON) that makes interpretation construction of authentic artifacts in the context of rich background materials the central focus. We have shown how this approach can be applied to design a Study Support Environment for teaching science and scientific reasoning to students not scientifically oriented We have also shown that in addition to learning specific content, students using these programs acquire generalizable interpretation and argumentation skills. Thus, our constructivist design framework is useful both for guiding design and for producing valuable learning results.

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Title:

Using a Knowledge Representations Approach to Cognitive Task Analysis.

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Task analyses have traditionally been framed in terms of overt behaviors performed in accomplishing tasks and goals. Recent research has described the central role of cognitive factors involved in performing jobs ranging from dairy truck loading (Scribner, 1984) to paper pulp manufacturing (Zuboff, 1988), ship navigation (Hutchins, 1990) and software debugging (Riedl, et al., 1991; Flor and Hutchins, 1991). Pioneering work at the Learning Research and Development Center looked at what contribution a cognitive analysis might make to current task analysis procedures (Glaser et al, 1986), since traditional task analysis methods neither elicit nor capture cognitive components of the job. In the current paper, we describe our approach to cognitive task analysis, and report some initial case studies trying out our methods.

Specifically, our approach has sought to capture two aspects of a job that have been generally overlooked by traditional task analysis: (a) describe job performance not only in terms of overt behaviors, but also in terms of the underlying knowledge content and thinking processes, (b) capture not only the formal but also the informal aspects of the job.

Drawing upon basic research in Cognitive Science we analyze knowledge about jobs into four knowledge representation types, namely factual knowledge, imagistic knowledge, procedural knowledge and mechanism (or mental model-type) knowledge (Black, 1992).

Factual knowledge gets at "knowing *that* something is the case". It is best represented as a propositional network (Anderson 1983). The basic unit for this kind of knowledge is the proposition, which is composed by a relation and the concepts or objects (idea units) that it interelates. Together the relations and idea units form a web of meaningfully interconnected ideas. Sets of highly interconnected ideas form schemas, that are integratve higher level units. Schema complexity is a measure of the sophistication of factual knowledge used in the performace of a task.

Imagistic Knowledge, refers to "knowing *what something looks like*". Although a mental image has pictorial elements it needs not to be an exact picture of the thing represented. Instead, the mental image is an arrangement of just the pictorial elements that constitute meaninglul imagistic properties of what is being represented and the spatial relationships between them. A useful represenetation of imagistic knowledge is the Pixel Coordinate Network, proposed by Kosslyn (1980). Through use of this representation the overall image can be mentally transformed, for example it can be segmented into subimages of meaningful pictorial elements with their specific spatial coordinate (a 'zoom in' kind of operation). These pictorial elements can be used for imagistic reasoning by means of such mental transformations. In our model, imagistic complexity is a function of the number of pictorial elements and density of the relationships between them. This serves as an indication of the sophistication of imagistic knowledge being used.

Procedural knowledge addresses "knowing *how* to do something". It can be represented as a system of production rules in the form of condition-action pairs. Simple production rules are clustered in plans which integrate highly interconnected actions. Having procedural knowledge accounts for more effortless free-flowing performance, in the execusion of a task. The level of sophistication of procedural knowledge is then indicated by plan complexity which is a function of: (a) the number of actions that are clustered in a plan and (b) the number of discriminating conditions to which the plan is sensitive (the number of alternative procedures for the same goal). In addition, the distribution of tasks among workers, by means of shared procedures, provides insightful descriptions of the underlying work organization.

Mechanism Knowledge is represented as a mental model. It involves knowing "*why* something works". (Stevens, 1983) It therefore refers to an understanding of the underlying structure of a system that allows for the procedures used to perform a task to have the desired outcome. While procedural knowledge allows smooth performance, a "mental model" provides easier derivation of new procedures and more complete diagnosis of problems that might arise. This knowledge is therefore important for tasks that vary a great amount and often involve dealing with novel situations. Mental model complexity (a function of the number of system components, the number of possible states of the mechanism and the number of transitions between these states) as well as mental model flexibility (the ability to represent the system in alternative ways relevant to particular problems) are used as indicators of the sophistication of the mechanism knowledge involved in the performance of a task.

We will refer to the four representations as FIPM in the rest of this paper.

Methodology

Our data collection is based on a combination of methods which stem from efforts in anthropology and cognitive science. The methods which were primarily used are as follows:

On-Site Observation

For on-site observation we draw upon the ethnographic methodological tradition. Ethnographic field methods are particularly suitable for documenting knowledge as situated (Brown et al., 1989) in a rich social context. We used observation to capture various aspects of the work context - physical space, work objects, social scene, actors and actions, time sequencing etc. In addition we entered the field with questions based on FIPM regarding observable clues as to the types of knowledge that the worker utilizes. For example, smooth execution of a task was indicative of possible existence of procedural knowledge. Our fieldnotes also include verbal reports by the workers about their various tasks.

Intensive Interviewing

A variety of interviewing techniques were used including storytelling, directed questioning and critical incident probes. In sequencing the interview techniques, it was important that the storytelling precede all other kinds of interviewing, which is in contrast to traditional task analysis protocols. We have adopted such a system for a number of reasons: (a) when open ended probes follow formal accounts of the job, elicited by means such as directed questioning, previous answers constrain storytelling (b) by capturing knowledge in context (in storytelling data) we are able to look at the FIPM knowledge representations as situated in rich contextual information including time sequencing, social interactions and affect. Having established this general context of knowledge we can direct our inquiry towards specific knowledge representations, without the danger that our data will be overly fragmented and (c) it provides "anchoring" which yields a more natural account of the type of information that we are looking for than does answering abstract questions. The subsequent question-answer processes are then facilitated by the fact that the worker and the researcher have established a concrete common ground of understanding.

Task Related Queries

The line of directed questioning is guided by the FIPM model as the questions probe for worker's use of particular knowledge representations. A primary tool used during this section of the protocol was that of the task matrix, a form which organizes workers' tasks in terms of the types of knowledge needed to perform those tasks. Information about this knowledge was elicited through verbal probes designed to capture the facts, images, procedures and mental models required in the performance of each specific task.

Critical Incident Probes

Critical incident probes are also FIPM based and are designed (a) to elicit alternative procedures to a goal and (b) to evoke mental models that may deal with atypical situations. In this case the FIPM notation served as a guide to elicit knowledge that is critical for efficient performance, even if it is not spontaneously evoked by the worker during the short period of data collection.

We addressed issues of reliability and validity, thus, through these efforts to triangulate research approaches. Through the examination of sites with such a varied assortment of tools, we were able to confirm our findings by looking for consistencies across data types.

After obtaining field notes and interview data from each site, researchers coded the notes into the categories of facts, images, procedures and mental models. In addition, the category "other" was used to hold data which did not fit into any of the above categories. This data in the "other" category was later partitioned into new areas such as goals, affect, social interactions, and technology integration. In cases where a given piece of information pertained to multiple knowledge representations, it was coded to include all of them. Each piece of data was then "tagged" with the worker's name, the observer's/interviewers name, the specific task to which the data related, and the portion of the protocol from which the data stemmed.

This method of coding allowed researchers to look at the data both by way of knowledge needed for specific tasks and by knowledge as it is organized independent of tasks. The structure of our data thus allows for flexible approaches to indexing patterns that exist across tasks, across jobs, and across workers. Each researcher examined for trends in the data, asking questions about: what types of knowledge are needed to perform each specific task, which types of knowledge representations are present in numerous tasks distributed throughout the workers' responsibilities, which tasks constitute larger patterns in the organization of a given job, and how do different workers characterize their jobs in terms of different knowledge representations.

Thus our FIPM model is guiding, but not constraining, our data collection. Targeted questions and task matrix related queries were used to ensure that the main tasks of the job are recorded and that their specifics are coded in terms of categories recognizable to researchers, as well as in terms of FIPM.

Preliminary Findings

The protocol has been performed at 14 sites in the New York, Los Angeles and Palo Alto areas, by ourselves and our colleagues at the Rand Corporation. For the purposes of this paper we will consider six of the sites at which the cognitive task analysis protocol was enacted and the resulting data was analyzed.

site 1 - x-ray technicians in a hospital
site 2 - records center clerks in a law firm
site 3 - customer service department in a paper company
site 4 - order entry department in a clothing manufacturer
site 5 - aides in a home health agency
site 6 - copying center in a law firm

It is useful to frame the evaluation of our work to this point with respect to three questions that address our framework and methodology: (a) Is the FIPM framework generic enough to base a domain independent methodology on? (b) are the distinctions that the proposed formalisms make meaningful with respect to the knowledge that workers have about their jobs? and (c) are the aspects of job related knowledge that our methodology captures significantly more informative than traditional task analysis?

We have found the FIPM model of knowledge representations to be broad enough for the development of a domain independent method of cognitive task analysis. Our methodology was successful in eliciting rich and meaningful data across cases in which the nature of the job and the organizational structure within which the job was performed varied considerably. Each of the four representations could accommodate a variety of knowledge content (knowledge about tasks, knowledge about the social context, etc.). For example, depending on the specific nature of each job, mental model knowledge probes were successful in eliciting mechanism knowledge, organizational system knowledge and also models of social interaction.

The formalisms proposed by the FIPM model allowed us to capture differences between jobs in terms of cognitive demands. Depending on the nature of the job, different types of knowledge appeared predominant.

In the hospital setting in which x-ray technicians were looked at (**site 1**), for example, we were able to elicit detailed imagistic knowledge regarding body marks and angulation which is used to correctly position the patient and the equipment. Imagistic knowledge was also critical to the task of successfully evaluating the diagnostic quality of x-ray films. Together with being able to characterize the x-ray technician job as heavily drawing upon imagery, which in itself may seem like a trivial finding, we were able to elicit visual reasoning, and to document how images are tied to the procedures used to execute the tasks. The following examples from the data illustrate this point:

> *[GU,* task list,*]:"They say that we have x-ray vision because we work in x-ray. Whenever I have a case on the body or the trunk, we don't know where your stomach is, I don't know where your liver is, where the vertebrae are, I have an idea, but we use body landmarks. Depending on your body landmarks, because your elbow, on everybody, you let your arm drop to the side of your body, your stomach is at the level of your elbow, your gall bladder is at the level of your elbow, your gall bladder is at the level of your kidneys which is about L1. If you just close your eyes and you just picture it, if I just bring it down I'll get this part of the body that I need. I do that, it gives me a better picture."*

> *[GU, Task-list, pp.20-21, supervising students, # M,I,P] E: What would be a kind of problem a student would come up with?*
> *G: A student? A kid, they take a hand x-ray, right? You do it like this, then like this. A kid's hand's in a cast and they want to straighten the figures out, but they can't because it's in a cast. So it's like how do I*

do it? Put his hand down and shoot it. His elbow is locked, he's supposed to do an AP elbow like this, right, what you're supposed to do is you're supposed to put it like this, shoot it like that, and you're supposed to put it down, shoot like that. What I do is I put it on the V and I shoot straight. They're confused, it gives you the same film, just a different way.

With respect to the last example, it is important to note that although the overt procedures used by the technicians are standard each time, for any given x-ray there is specialized knowledge which informs and alters the technicians' procedures. The alternative procedures which experts have at their disposal involve considerably more than procedural knowledge. Cognitive task analysis has allowed us to elicit information about the facts, images and mental models which inform these procedures. Our ability to gather this kind of data speaks to the strengths of the FIPM framework, especially in comparison to other methods of task analysis.

The records clerk job (**site 2**) in a law firm record center provides another example which relates to this point. The record center job is highly procedural and all of its main tasks can be broken down into a series of steps: indexing, filing, binding, searching etc. Varying facts are continuously plugged in the procedures and specify alternative routes for execution. For example, the document's age indicates whether it should be searched in the on-line system or in the warehouse indexes and the type of law determines how documents will be bound. Given these characteristics this job, together with sites 3, 4 and 5, can be said to belong to a broader category of jobs related primarily to information processing.

The sophistication and volume of the record keeping aspects of this job, however, differentiates it from the other information processing sites. Through applying cognitive task analysis we were able to discern the particular cognitive functions demanded of these employees and recognize thinking skills that benefit performance in the position. The file clerks deal with a vast and complicated body of facts with rigorous schemas for coding and filing. They are intimately familiar with the files to which they are assigned and regularly recognize information such as the names and numbers of clients and cases from memory. The clerks are also familiar with types of law and types of legal documents, in addition to knowing relevant information regarding other company employees.

Factual information is at the core of all the procedures which records center clerks perform. Examples of tasks they are responsible for include filling a request form by phone and receiving one over the printer which in turn would initiate a search. New knowledge is generated by using these facts around requests against their filing knowledge and experience. Problem solving often revolves around successfully completing a request where there is not sufficient information about the document requested. This usually involves (a) making inferences from the available information to narrow down the query (b) doing searches using the computerized and/or physical indexes or using the files themselves, or (c) attempting to obtain more information by communicating with the person requesting the document or that person who is holding it. Therefore problem solving takes the form of querying an elaborate network of facts, both within the clerks own knowledge and within that knowledge imbedded in the firm's database systems.

These findings suggest that indexing knowledge according to the proposed model is based on distinctions (among facts, procedures, mental models and images) that are meaningful. Cognitive task analysis allowed us to gain insight into the rich web of factual information record clerks employ in their procedures. Through this analysis, we were able to recognize differences in the cognitive skills needed across jobs that would on the surface all appear to serve the function of "information processing".

Apart from distinctions pertaining to the nature of the job, our data also reflected differences in the knowledge that front-line, entry level workers possess as a result of the organizational structure in which they perform their work. This analysis provides valuable information with respect to the issues that this study was designed to inform, namely the changes in skill demands that are going on in today's workplace. In moving through our sites of study, we recognized two significant trends in skill demands occurring within our sites which are in direct contrast to one another. One trend is that of transforming traditionally low-skill front-line jobs, such as clerical jobs, into ones which provide front-line workers with increased responsibility and access to information. The contrasting trend is placing de-skilled laborers in front-line positions. We see this occuring in fields where front-line positions have traditionally been filled with highly skilled workers. We found cognitive task analysis to be an adept tool which enabled us to recognize significant distinctions in the effects of these organizational decisions on worker's knowledge and performance.

Site 3, the customer service department of a large paper company, provides an excellent example of an organization which has attempted to provide entry-level, front-line workers with increased access to information and responsibility. Three years before we examined the firm, it had gone through a structural re-organization which moved traditionally segmented processes such as order entry, customer service, and billing, into "high-performance work teams" that were responsible for "all aspects of the revenue cycle". The teams were made up of typically five to seven employees who shared responsibility for meeting performance goals. Within each team, workers rotated procedures on a bi-monthly basis in order to gain experience in a variety of work related skills. Team members worked closely with one another, continually asking questions and exchanging pertinent information about the organization, about their customers, and about social activities- for example their daily and weekly schedules. This team based environment allowed knowledge to be exchanged very easily, in a manner which accommodated the workers' immediate needs. We found this organization made unique use of the workers' knowledge, and allowed them to continually add to this knowledge set.

As was argued earlier, data about job related knowledge that is not apparent in performance, can prove to be highly informative about the nature of a given position. **Site 4**, the data entry department of a clothing manufacturing company, serves as another example in this argument. Data entry is a job that if it were to be described as a list of observable behaviors would appear to be a series of mechanistic actions. And in fact, in the cognitive aspects of the job as described in our FIPM schema, procedural knowledge is predominant. However, we were also able to elicit factual knowledge about the company that doesn't appear to be necessary to perform this particular job, as well as a systems understanding of the company's organization and the flow of information between different parts of the company (which we classify as being mental model knowledge). In addition, open-ended questions aimed at capturing cognitions about the social context also elicited informal knowledge (procedural) about efficiently communicating with other departments of the company.

Workers in site 3 made an interesting contrast against those in site 4. While the customer service employees were responsible for the same order entry duties as the workers in site 4, the customer service activities were done in the context of the "entire revenue cycle" which the team was responsible for. Through rotating tasks related to all aspects of this cycle, workers attained rich mental models about the organizational systems in place. And by being organized in such a way that this knowledge could be transmitted easily, the entire team benefited from individual worker's knowledge gains. While in both cases we elicited evidence of systemic knowledge, we saw that the customer service workers were asked to use this mental model knowledge continuously in order to manage tasks surrounding the revenue cycle. Their job was described as being "multi-functional", and all of these various functions were concerned with this cycle. The data entry employees in site 4, while having some mental model knowledge surrounding their procedures, were generally not asked to use this knowledge in the course of their work.

The difference between these two organizational structures and the way in which workers knowledge is utilized is marked and appears to account for striking differences in performance. The customer service department at site 4 is able to function virtually without supervision, and is able to experiment and find solutions to problems in a way that the workers in the other site did not approach. By organizing responsibilities in this manner, workers were better able to troubleshoot and make high-level decisions about specific cases. When asked to describe workplace success stories, these employees generally answered with cases relating to a high-order change they brought about in their work processes. This is in contrast to the workers in site 4, whose success stories related to common procedural problems which they were able to overcome.

Additionally, by organizing the worker's responsibilities in terms of the whole revenue cycle, workers were able to use factual information pertaining to their responsibilities in multiple procedures. For example, the customer service employees were responsible for procedures such as handling orders, entering data, coordinating with trucking and mills, collecting payment, and resolving deductions. Within this group of procedures, we saw a tremendous overlap in terms of the factual information needed to perform these procedures. Examples of this factual information include, information about the customer, price of products, warehouse location, and shipping date. This organization of facts and procedures is in contrast with that of the clothing manufacturer, as well as with most traditional organizational efforts. Tracing the path of facts and procedures within the organization not only lends evidence for the differences between these particular sites, but also points to cognitive task analysis as a tool that can serve to evaluate organizational structures in terms of these differences.

A parallel contrast which also looks at skills demanded of entry-level, front line workers concerns sites 1 and 5. In case study 1, we looked at x-ray technicians working in a hospital setting. **Site 5** involves home health aides who provide health care in the greater Los Angeles area.

The primary responsibilities of the home health aides in case study 5 revolved around driving to patients homes, collecting information about the patients' well-being, and recording this information in a uniform manner. Aides were also responsible for bathing the patient, in addition to several other incidental chores. In cases when aides discovered abnormal occurrences, they would confer (via telephone) with their supervisors about the case, and proceed to follow their supervisors' instructions. The job requires very little in the way of imagistic, factual, or mental model type knowledge. The procedural knowledge needed by these workers generally revolved around their asking questions, bathing patients, recording information, and scheduling visits. The agency which employs these aides also employs LVNs, RNs, and medical doctors. It is these more advanced employees who take on diagnostic health care duties.

Our analysis of case study 1 showed that the x-ray technicians utilized comparatively more varied and involved knowledge in the course of their duties. Here, we saw workers incorporate involved factual, imagistic, procedural and mental model knowledge in areas as diverse as human anatomy, x-ray equipment functionality, and radiology. This knowledge allowed workers to obtain x-rays even in cases where the health status of the patient was unusual, or the circumstances behind the x-ray were out of the ordinary. In addition, the x-ray technicians' knowledge went clearly beyond proper use of the equipment and patient positioning, into medical knowledge about which types of medical procedures require particular types of x-rays. This knowledge allowed technicians to continually reassess their methods according to their given situation.

The x-ray technician's job is presently a high skill entry level job that requires state licensing and certification. While we were on site, the technicians repeatedly voiced concern about a trend in health care reform which would eliminate this licensing requirement. Workers believed that the training which accompanied licensing was a mandatory prerequisite for safe and intelligent operation of x-ray equipment, and was critical to their patients' health and well-being. This same trend appeared to have already occurred in the home health field, where RNs and LVNs were increasingly being replaced by aides. Although in most cases, surface level observations of tasks which these positions are responsible for appear to be straightforward, there are many procedures, as was described earlier, which are significantly informed by deep underlying knowledge. As the trend to de-skill these entry level, front-line workers continues, there is a threat that the de-skilled workers will not have sufficient knowledge to inform decisions in an adequate portion of the cases they are exposed to.

We see, then, that a traditional job description of the home health aide and the x-ray technician positions would yield considerable similarities. On the surface, both work to provide health information for doctors who would then go on to analyze that information. The cognitive task analysis approach yields stark differences between the knowledge needed in order to perform the two positions, as well as in the worker's ability to adapt and work through critical incidents.

Indexing knowledge in terms of facts, images, procedures and mental models has thus yielded distinctions between jobs that capitalize on a major insight of cognitive science, namely that forms of knowledge can be made distinct and may account for performance. In addition, our emphasis on ethnographic and unstructured interviewing methods provide us with rich interpretive data. Together these provide a means by which cognitive task analysis may be performed that incorporates the rich contextual information inherent in the workplace.

Summary of Conclusions, and Implications for Research and Development

The FIPM model of cognitive task analysis has enabled us to make unique distinctions between jobs in terms of the knowledge required to perform those jobs. We feel as though one area which may significantly benefit from these sorts of findings is that of job descriptions. Were jobs to be described not in terms of overt acts, but in terms of cognitive activities, we may be able to enact a system which better matches cognitive skills, to tasks which incorporate those skills. Also, by placing these descriptions in situated accounts, job seekers may begin to have access to materials which more accurately reflect the positions they consider.

Cognitive task analysis has also exhibited great potential for informing areas that surround organizational structure. In each of these cases described, and in all of the sites we visited, we found that workers had knowledge about their organization which went far beyond that which was required of them to perform their job. This knowledge often came about through informal processes in which information about the organization was exchanged. As stated in the section contrasting the customer service group (site 3) with the order entry department (site 4), workers can put this knowledge to effective use in cases where the organizational structure permits such activity. Cognitive task analysis, then, may serve as a tool to inform organizational decisions around how to best structure workers so that the organization makes most effective use of their workers' knowledge. An effective structure would optimize performance, as well as allow knowledge to be transmitted between workers in a productive manner. In our study, we have found that those organizations which allow workers to put their knowledge to full use and those which are structured in such a way that informal knowledge is communicated between workers on a regular basis, demonstrate differences in both attitude and performance.

In terms of methodology, we found that the task matrix approach to querying subjects was successful in its allowing us to verify our field notes, reduce jobs into a group of meaningful tasks, and in its ability to describe each of these tasks in terms of the knowledge types required for performance. While the data which came out of the task matrix was largely qualitative (due to the fact that each subject had varying ideas about what constituted an image, fact, etc.) we see an opportunity to further hone this methodology into one which could be analyzed quantitatively. As we are better able to develop cues which are more definitively interpretable, we will be able to more powerfully recognize correlations in the way people think about their work. A major goal as far as future efforts are concerned, then, is to hone our methods so that they may better correlate with the type of data they are expected to elicit.

Another important aspect of this research concerns the ability for the workplace knowledge to be represented and used to inform instruction and training efforts. To the degree that our research was done within the workplace and attempted to characterize events in the actual context of their taking place, the data we draw upon in analysis is specifically situated in workplace culture and attitudes. Additionally, this data is well-structured around both the given tasks and the types of knowledge which are required for performing those tasks. Cognitive task analysis, thus, is a potentially viable source for site-specific, situation-based educational materials (Ferguson). We see that materials of this nature are used in instructional technology corporate training efforts, as well as in elementary schools (Black & Liepolt)

Through examining and formalizing the knowledge workers need in order to perform their jobs, we also were able to gain a unique look at the types of materials used in supporting these cognitive activities. We feel as though there is considerable possibility for analytic tools such as these to be used in examining the phenomenon of shared cognition. Workers in **site 6**, the law firm copy center, for example, relied considerably on the ability of their machines to provide feedback and guidance. We witnessed cases in which employees were able to use knowledge about this interface to "trick" the machine into performing tasks other than what the interface would otherwise lead an observer to believe. As these relationships between technology and workers grow more prevalent and complex, new tools will need to be developed which analyze these relationships, and aid workers in performance.

In summary, we have established that our model of knowledge representation is effective in capturing rich knowledge content both in relation to the performance of specific tasks and in relation to the general work setting. Future efforts in this area may have significant effects on areas such as job classification, industrial organization, instruction and technological implementation.

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Title:

A "Layers of Negotiation" Model for Designing Constructivist Learning Materials

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A "Layers of Negotiation Model" for Designing Constructivist Learning Materials

Many authors have questioned whether traditional instructional design models are suitable for designing constructivist learning materials (see, for example, the May and September 1991 issues of Educational Technology). Although Winn (1991) questions whether "traditional procedures and assumptions of instructional design" can be applied to designing materials for constructivist learning environments, he admits that "... while instructional design by constructivists may seem to be a contradiction in terms, there is still a lot of designing to do." (p. 39). In designing materials for use in a constructivist learning environment, instructional designers still have a role in selecting the situations that may provide a stimulus for knowledge construction and providing features that support students and teachers in using these materials (Young, 1993). However, Winn (1991) indicates that designing materials for constructivist learning environments "requires a change in the assumptions about how people learn and about how instructional decisions are made "(p. 38). These discussions imply that the processes of instructional design, not just the products, must be revised to accommodate constructivist ideas about learning.

The purpose of this paper is to discuss the process of designing a series of case-based interactive videodiscs to be used within a constructivist learning environment. The cases present two elementary teachers and their students as they progress through science lessons based on the conceptual change model of science teaching (Cosgrove & Osborne, 1985). The two hours of videodisc footage were condensed from approximately 60 hours of videotape documenting actual classroom events occurring during 2 weeks of science instruction in two classrooms. The three cased include a 1-week lesson on levers (5th grade), a 1-week lesson on inclined planes (5th grade), and a 2-week lesson on seeds and eggs (1st grade). The discs illustrate a variety of on-location classroom events: student investigations, small group interactions, student record keeping, large group discussions, and demonstrations. Dual audio tracks allow the viewers to hear either the classroom events or the teacher's reflections on the classroom events. This set of video-based cases provide a context for preservice elementary science teachers to engage in reflective thinking. Using these materials, students have the opportunity to seek answers to questions that evolve from their interactions with the materials, explore the stages in conceptual change science teaching, and gain experience with reflection on teaching.

As we designed these materials, we were guided by a set of constructivist assumptions about learners and learning. These assumptions had implications for the learning materials and, we believed, for the instructional design process. We assumed that traditional instructional design models would not provide adequate guidance in designing these materials; instead, we sought to design our materials guided by our assumptions about teaching and learning, and once the materials had been developed, to reflect back over the design process and compare our procedures with those prescribed by traditional models. This paper documents that process: we outline the assumptions about teaching and learning that guided our design efforts, we discuss the implications of these beliefs for the instructional materials, we describe our design process, and finally, we derive some generalizations about the differences between our process and the procedures recommended by traditional instructional design models that may be of use to other designers.

Assumptions about learners and learning

We assume that learners come to an instructional setting with a wide variety of background experiences that have shaped their understandings, beliefs, and values. Thus, the meaning that a learner derives from an instructional experience may not be the same as another learner's; an individual's experience is mediated through a unique filter of understanding, beliefs and values (Freyberg & Osborne, 1985). Learners may focus on different inputs or all may attend to the same data. Similarly, there is no guarantee that an instructional intervention will "work" for every student; student's ideas could be uninfluenced or influenced in unanticipated ways by the intervention, depending on the learner's action on the experience (Gilbert, Osborne, & Fenshem, 1982).

We believe that learning is a process of sense-making, of assimilating new information within existing knowledge structures, and adjusting prior understandings to accommodate new information. In order to facilitate the assimilation and accommodation of new experiences, we believe that disequilibrium is essential. Learners must be dissatisfied with their existing knowledge and beliefs in order for learning to take place (Posner, Strike, Hewson, & Gertzog, 1982).

In addition, we believe that learning is a social enterprise. Learners can become dissatisfied with their existing knowledge when they compare their ideas with ideas of others, both experts and peers (Solomon, 1989). Thus, through this sharing of knowledge, learners may find new ideas that are intelligible, plausible, and useful alternatives. Through social interactions, as well as through action on objects, learners make sense of the world.

Implications for learning materials

Grounded in our beliefs about the nature of learners and learning, are implications for the learning materials. We recognize that learners may come to the instructional setting with varied background knowledge, beliefs, and attitudes; therefore the materials must be capable of supporting a variety of learners possessing a variety of perspectives as they attempt to create meaning from the instructional materials. Similarly, meaning is not inherent in instructional material; instead meaning is created by learners as they interact with the materials, with the teacher, and with other learners.

From her synthesis of recommendations from numerous researchers "attempting to articulate constructivist theory", Driscoll (1994, p. 365) identifies five conditions that should be incorporated within constructivist learning environments. She suggests that constructivist learning environments should:

1. Provide complex learning environments that incorporate authentic activity.
2. Provide for social negotiation as an integral part of learning to allow insights to emerge through the group process that may not come about otherwise.
3. Juxtapose instructional content and include access to multiple modes of representation to allow learners to examine materials from multiple perspectives.
4. Nurture reflexivity, or awareness of one's own thinking and learning processes.
5. Emphasize student centered instruction, where students are actively involved in determining their own learning needs and how those needs can be met.

As the following discussion illustrates, our materials incorporate each of these recommendations.

1. Provide complex learning environments that incorporate authentic activity. We recognize that classrooms are complex environments where many events occur simultaneously. Using interactive videodiscs of actual classroom lessons, the preservice teacher can enter a classroom virtual world. Viewers can begin to identify problematic classroom events through the rich visual and verbal cues provided via videodisc. Rather than provide brief vignettes of exemplary teaching (see, for example, Goldman & Barron, 1990), we choose to present three complete units of science instruction. The viewers witness the natural progression of events as they unfold over a one or two week time period. They see things that work and things that don't. They witness the teacher's daily reflections on the classroom events, her frustrations, her pride, and her careful consideration of alternatives for action. In this way, the complexity of the classroom environment is maintained in authentic recordings of the classroom events.
2. Provide for social negotiation as an integral part of learning to allow insights to emerge through the group process that may not come about otherwise. As these cases are used in university methods classes to coach preservice science teachers to become reflective practitioners, social negotiation is an integral part of the teaching/learning process. A series of written and oral reflective tasks cumulate in large group discussions where students critically analyze various classroom episodes from the videodiscs. As they examine their beliefs and values about teaching science, they may find that their theories are challenged by other ideas that emerge through group discussions (Abell, Cennamo, Anderson, Bryan, Campbell, & Hugg, in press). Although the class may seldom reach consensus, each student builds upon his or her own personal theories based on these experiences. In this way, insights about teaching and learning science emerge through the group process that may not occur otherwise.
3. Juxtapose instructional content and include access to multiple modes of representation to allow learners to examine materials from multiple perspectives. The materials provide students with access to multiple modes of representing the classroom events. The videodiscs contain dual audio tracks that allow the users to either hear the naturally occurring classroom audio or the teachers' reflections on the classroom events illustrated in the video. The videodiscs are accompanied by a HyperCard stack that includes student products, background information on the school, additional information on the teacher and students, lesson plans, and reference materials. As students explore

the materials, they can read the lesson plan, see the classroom events, listen to the teacher's reflections on the classroom events, examine student products, read more about the students, learn more about the teaching strategies used in the lesson, or access several other frames of information related to a single classroom event. With the random assess possible with computer-controlled interactive videodisc, users can juxtapose information in a sequence of their own choosing and examine the content from multiple perspectives.

4. Nurture reflexivity, or awareness of one' own thinking and learning processes. Our interactive video cases are designed to encouraged preservice teachers to become aware of their own thinking and learning processes. A number of written and oral reflective tasks have been developed for use in conjunction with the video cases. These tasks systematically and developmentally attempt to help preservice teachers: 1) uncover their local theories of science teaching and learning; 2) recognize the role that personal histories of science learning play in their local theories; 3) realize that classrooms are complex and that classroom observers focus on various attributes; 4) frame issues that arise during science instruction; and 5) reassess their own theories in light of their own and others' classroom practice. Thus the video cases encourage reflection about teaching and learning.
5. Emphasize student centered instruction, where students are actively involved in determining their own learning needs and how those needs can be met. As described above, the materials allow users to choose several modes of representation in order to meet their information needs. In addition, several lines of investigation can be pursued. These materials can be used to better understand the lesson stages in conceptual change science teaching (Cosgrove & Osborne, 1985), children's ideas about science, the science content, or reflection on teaching. The materials are designed to be used with ease in large groups, in small groups, or individually. Thus, the materials provide students with the flexibility to explore in ways that allow them to determine their own learning needs, to determine how those needs can be met, and to pursue information to meet these needs within the context of elementary science instruction.

Implications for the design process

In designing the interactive video case materials, our beliefs about the nature of learning also had implications for the instructional design process. Just as constructivists emphasize the process of learning, rather than merely the product, we believed that the process of designing these materials, not just the product, should be consistent with constructivist theory. Not only should the materials themselves be developed for use in a constructivist learning environment, but we believed that the materials should evolve though a process of construction of knowledge, reflection, and social interactions. In retrospect, we propose that Driscoll's (1994) five conditions for constructivist learning environments can be transformed to apply to the process of designing materials from a constructivist perspective. We suggest the instructional design process should include the following conditions:

1. Embrace the complexity of the *design* process.
2. Provide for social negotiations as an integral part of *designing* the materials.
3. Examine information relevant to the *design* of the instruction at multiple times from multiple perspectives.
4. Nurture reflexivity in the *design* process.
5. Emphasize *client-centered design*.

Although we addressed these five conditions throughout the entire instructional design process, for simplicity, we will illustrate each condition as we describe one aspect of designing and developing our materials. After recording approximately 60 hours of videotaped footage, a we faced a major task in selecting the video segments to be included within two hours of disc space. The process we followed in accomplishing this complex task is described below:

1. Embrace the complexity of the *design* process. Instructional design has traditionally been a prescriptive science (Regeluth, 1983); however, we found that attempting to simplify the design process and apply strategies that had worked in other situations had the potential for limiting the richness of our product. Foremost in our minds was to create "cases" of conceptual change science teaching in elementary classrooms. In order to make decisions on the footage to be included on our disc, the project team had to agree upon what would constitute a classroom "case." At first we looked for prescriptions for this design dilemma. However, our cases were different from most in that they were video-based, rather than print-based, thus, guidelines for constructing cases (e.g., Carter, 1992; Shulman, 1992) were insufficient. Guidelines pertinent to videodisc cases in elementary mathematics (see Goldman & Barron, 1990) provided some clues. Yet, the nature of science compared to mathematics teaching presented some unique needs. In addition, we knew that our lessons extended over several days and that it would be necessary to capture the instruction over this extended time. Thus, instead of relying on

any existing set of prescriptions, we accepted the need to embrace the complexity of our task and to create our own process for selecting video segments.

2. Provide for social negotiations as an integral part of *designing* the materials. After rejecting a prescribed way of selecting scenes for inclusion on our disc, we engaged in extensive negotiations to identify appropriate scenes. Our selection process began by establishing a shared perspective among team members (2 methods course instructors, 1 graduate assistant, 1 science content specialist, and 1 instructional designer) on the types of scenes needed. We discussed the needs of our particular audience and instructors relative to our content: the need to illustrate key stages in the lesson, problematic classroom events, and examples of the teachers' reflection in action. We decided to search tape logs for scenes that would represent topics we discussed in our classes, that exemplified particular teaching strategies, that demonstrated children's conceptual development, and that illustrated the complexities of classrooms.

   Throughout this process each team member had to negotiate his or her perspectives with other team members. Since each of us came to the project with different experiences and expertise, we needed to share our "cultural knowledge" (Driscoll, 1994) in order to defend our selections. Our reasoning often included what we did in our classes, what we believed about teaching and learning, and what we understood about the science content involved. Through this negotiation of shared meanings we were able to create a richer product. Our collaborative problem solving became a key component in the design process.

3. Examine information relevant to the *design* of the instruction at multiple times from multiple perspectives. Spiro and his colleagues (Spiro, Feltovich, Jacobson & Coulson, 1991) state that "revisiting the same material, at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives is essential for attaining the goals of advanced knowledge acquisition" (p. 28). We contend that it is also important for the instructional design team to continually revisit the same data or ideas at different times, in rearranged contexts, and for different purposes in order to create rich environments for learning complex skills.

   As we identified segments from our videotaped footage, we noted how they could be used to illustrate multiple ideas in the university classroom. We found that we needed to revisit our footage several times. After our initial selection, we created a rough edit of our footage that was approximately twice as long as our finished product. We reviewed this tape extensively to determine whether the continuity of the lesson was maintained and to identify segments that could be shortened or eliminated. A second rough edit was necessary before we made our final edit decisions. We found that we often had to add sections to maintain the continuity of the lesson. Using our second rough edit, we began to match the teachers' reflective segments to the classroom footage. As the tape was reviewed by potential users of the product (university elementary science methods instructors) and the instructional designer, each individual examined it from his or her perspective as influenced by our previous discussions. As we revisited this data at different times, in various contexts, and with different purposes in mind, we maintained the richness inherent in the original event, yet shortened it to a manageable time frame for classroom use.

4. Nurture reflexivity in the design process. When reviewing instructional materials, instructional designers and subject matter experts typically focus on different facets of the instruction (Saroyan, 1993). Reflexivity is critical to understanding multiple perspectives and to articulating and defending individual beliefs. As we engaged in the social negotiations necessary to finalize our edit list, we were forced to clearly articulate our reasoning and to become aware of other positions. We had to explain not only which segments to keep or cut, but why. Each of us viewed the footage from our individual perspectives, influenced by our past experiences and beliefs. Each of us had a valid perspective on the information needed on the disc. It was critical for each of us to be aware of the reasoning behind our perceptions in order to clearly negotiate the selection of the final videotape segments.

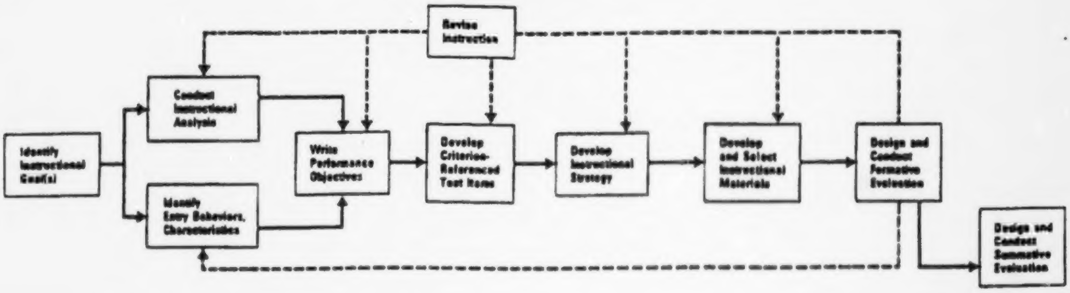
5. Emphasize *client centered* design. Most designers can recall situations where the client approved an initial product design, but when the final product was delivered, felt that it wasn't quite what they had in mind. Many clients are a little unsure exactly what they want initially; unlike experienced designers, they are unable to envision the finished product until they see it. With client-centered design, clients are defined as representative of those who will ultimately use the materials for instruction, rather than those who fund the project. These clients, in collaboration with the instructional designer, must be actively involved in determining what their needs are and how those needs can best be satisfied. As we designed our materials, those who would eventually use the materials for instruction were actively involved in all phases of the design process. At each stage in the process, they had an active voice in determining their information needs and how those needs could

best be satisfied. Using this approach, the clients were able to refine their needs as the project evolved, to clarify needs as additional data became available, and to constantly be involved in decisions at each stage in the design negotiation process.

Analysis of the Process

Although we did not follow a traditional model of instructional design, in retrospect, we believe that our design process was indeed systematic. Unlike the process outlined in traditional instructional design models (e. g. Dick and Carey, 1990; see Figure 1), we did not proceed through discrete stages of analysis, design, development, and evaluation. Consequently, the output of one stage in the model did not provide the input for the next stage. However, the majority of issues addressed by traditional models of instructional design were addressed as the design and development of the case-based interactive video materials evolved through the construction of shared meanings. As in Tessmer and Wedman's (1990) "Layers of Necessity Model" of instructional design, the design of our materials evolved in a spiral, layered fashion. But whereas Tessmer and Wedman's model suggests that designers select a layer of precision based on the time and resources available to the designer, in our "Layers of Negotiations model", we suggest that designers proceed to deeper levels in the process when additional data becomes available or relevant to the discussions. When designers embrace the complexity of the design process and emphasize client-centered design, social negotiations become an integral part of the design process. As designers and clients negotiate shared perspectives, both parties are required to become reflexive and articulate their thought processes. Through this process, ideas and data are examined from multiple perspectives.

Figure 1
Systems Approach Model for Designing Instruction
(Dick and Carey, 1990)


Revise Instruction
Conduct Instructional Analysis
Identify Instructional Goal(s)
Identify Entry Behaviors, Characteristics
Write Performance Objectives
Develop Criterion-Referenced Test Items
Develop Instructional Strategy
Develop and Select Instructional Materials
Design and Conduct Formative Evaluation
Design and Conduct Summative Evaluation

THE DICK AND CAREY SYSTEMS APPROACH MODEL FOR DESIGNING INSTRUCTION

Our "Layers of Negotiation" process is characterized by a number of distinctions when compared to traditional instructional design models:

Question driven rather than task driven. Rowland (1992) suggests that instructional designers should focus on asking good questions, rather than simply following the "steps" prescribed by traditional instructional design models. Using the Dick and Carey (1990) model as an example, we found that although we did not proceed through the steps in a linear fashion, we addressed most of the questions posed by the model (see Figure 2). However, the answers to many of the "questions" posed by the Dick and Carey model of instructional design were very different from those suggested by Dick and Carey (1990). In addition, as the design and development of the case-based interactive video materials evolved through a process of reflection and social negotiations of shared meanings, we never performed a formal instructional analysis or developed learning objectives. Instead, we performed a content analysis of our videotape footage to identify patterns of events and clustered them for access by the learners. Consistent with Jonassen's (1991) recommendations, our analysis focused on considering various interpretations of the content and providing the "intellectual tools that are necessary for helping learners construct knowledge" (p. 12).

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Figure 2
Sample Questions Based on the Stages in the The Systematic Design of Instruction
(Dick and Carey, 1990)

Identify Instructional Goals

What should be included in the curriculum?
Is time and money available for development of the materials?
How should the needs be assessed?
Who are the learners?
What is the goal of the learners?
Can the learners achieve the goal?
Does the need of the stakeholders match with the goal of instructional materials?
Are there sufficient people to complete this material?
Is there sufficient time to complete this job?
Are these goals acceptable to those who must approve this instructional development effort?
Will the development of this instruction solve the problem which led to the need for it?
What is the content to be taught?
Is content stable enough to warrant the cost of development?
Are the learners available?
Is the designer experienced in content or instructional design?

Identify Entry Behaviors and Characteristics

What are the critical entry skills required of students before the instruction?
What is the learner's general ability level?
What is the learner's previous experiences?
What is the learner's expectations about instruction?
How will the learner's characteristics impact the design of instruction?

Conduct Instructional Analysis

What are the goals of instruction?
What will be taught?
What is the learning domain of the target skill?
What would a learner be doing when performing the goal?
What are the subordinate skills to reach the goal?
What is the relationship between these skills?
What skills can be omitted from the instruction?
What is it that the students must already know how to do, the absence of which would make it impossible to learner this subordinate skills?

Write Performance Objectives

What is it that the learner should be able to do at the end of the instruction?
Under what conditions should the learner perform the target tasks?
What are the skills the learner has to perform?
What criteria will be used to assess the performance of the learner?
What is expected of the learners?
What are the objectives for the entry behaviors?

Develop Criterion-Referenced Test Items

How will learning be assessed?
What will be tested?
When will be evaluated?

How often the learners be evaluated?
What is the criterion level to be considered as mastery?
What kind of feedback will be used?
Do the test items match with objectives?
By what methods will the learning be assessed? e.g. paper-pencil, observations, etc.
Do the test items match the behavior and the conditions specified in the objectives?
Do the test items provide students with the opportunity to meet the criteria needed to demonstrate mastery of objectives?
How many test items should be used?
What is the weaknesses/benefits of selected type of tests?
How long will the assessment require?
How much time is required for students to complete the test?
What will the testing environment be like?
What is the probability of guessing the answers?
Did the assessment undergo formative evaluation?
Who would administer the assessment to students?

Develop Instructional Strategy

How will the information be chunked (clustered)?
How will the information be sequenced?
What pre-instructional strategies will be used?
How will learners become motivated?
How will they become aware of the necessary prerequisite skills?
How will they be informed of the objectives?
How will the information be presented?
What information be presented?
How will examples be used?
How will the learners participate in instruction?
How will feedback be provided to the learners?
When will learning be assessed?
How long would it take the learners to learn the skills?

Develop and Select Instructional Materials

What are the instructional strategies to be used?
Should the materials be for individualized or group instruction?
Are there existing materials that can be used?
What is the intended delivery mode for the instruction?
Which media will be used?
How and when will the assessments be administered?
What should be included in the instructors manual?
What is the role of instructor?
How should the instructor use the materials?
What is included in the student materials?
How should the students use the materials?

Develop and Conduct Formative Evaluation

Does the content expert believe the content of the materials is accurate?
Does the content expert believe the content of the material is current?
Does the learning specialist believe the target population will have potential problems with the materials?
How does the learning specialist think the prospective learners will react to the materials?
What do the target learners say about the material?
What is the most obvious errors in the instruction when used by the target learners?
What is the initial reactions of the target learners to the content?
Can learners use the materials without interaction with the instructor?

Are the changes effective?
Are there additional errors or problems with the materials?
Do the target learners believe the instruction is interesting?
Do the target learners understand what they are supposed to learn?
Do the target learners believe the materials are directly related to the stated objectives?
Do the target learners believe there are sufficient practice exercises included?
Do the target learners believe the practice exercises are appropriate?
Do the target learners believe the tests really measure their performance on the objectives?
Do the target learners believe they receive sufficient feedback on their practice exercises?
Do the target learners believe they receive sufficient feedback on their test results?
Do the target learners believe the enrichment or remedial materials were satisfactory?
Can the materials be used effectively in the intended instructional settings?
Who will conduct the formative evaluation?
What instruments will be used?
What kind of data will be collected?
Are the materials designed efficient and effective?
What problems do the materials have when actually used?
What is the time needed to complete various components of the instruction?

Process-based versus procedure-based design. Whereas traditional instructional design models prescribe a set of procedures to be followed to design instruction, we found our emphasis shifted to the process of decision-making that is involved in designing instruction. With a client-centered design process that emphasized reflexivity, the act of decision-making became an important aspect of the knowledge building which contributed to the design and development of the materials. Just as learners come to an instructional experience with understandings, beliefs ,and values that have been shaped by their prior experiences, members of the instructional design team also begin the process of designing instruction with their individual sets of understandings, values, and beliefs. The process of designing instruction included negotiating a set of shared beliefs that guided the development of the materials. Initial discussions focused on creating a shared philosophy of learning, identifying the type of knowledge change desired, and determining ways to assess the learners' knowledge development. Examining instructional decisions from the multiple perspectives and "cultural knowledge" of the individuals in the design team enhanced the possibilities that emerged from the design process.

Spiral cycles rather than discrete stages. Whereas traditional instructional design models (e.g. Dick and Carey, 1990) include discrete stages for analysis, design, development, and evaluation activities, we addressed the questions of design in a spiral fashion, progressing through a series of steps at one level, then spiraling back and adding more detail within. We initially made decisions across stages based on the data we had available, then as more information became apparent or relevant, we spiraled back and added more detail across stages. In our model, as is Tessmer and Wedman's (1990) Layers of Necessity Model, "each layer is a merged set of tasks or questions that cut across the discrete stages of traditional models. Layers are not distinguished by the type of task *per se*, but by the level of complexity associated with the tasks in that layer." (p. 81). As we revisited the same material, at different times, for different purposes, we built on ideas generated at previous levels in iterative, knowledge building cycles (Rowland, 1992).

> While [traditional] models may have iterative features that allow for a reconsideration of earlier design activity outputs, they emphasize closure of each component in the process to serve as input to the next component. A layered approach assumes that components of the ID process will be repeated to a greater degree of precision and sophistication in subsequent layers of the process. This repetition is not for the purpose of revision earlier components ... but of adding onto the work that was done earlier. (Tessmer & Wedman, 1990, p. 80)

Conclusion

We approached the design process with the belief that believe that instructional design requires us to make decisions based on our assumptions about "how people think and learn rather than mechanically to apply procedures laid out in an instructional design model" (Winn, 1991, p. 38). A set of assumptions about the nature of the learner and the process of learning led to implications for the instructional design process. As we transformed recommendations for constructivist learning environments to the process of designing materials from a constructivist perspective, we attempted to embrace the complexity of the design process, recognizing social negotiations as an integral part of designing the materials. Furthermore, we emphasized client-centered design, examining the instructional content from multiple perspectives and nurturing reflexivity in the design process. As we analyzed our design process, we found that it differed from traditional models of instructional design in three primary ways. 1) We did not proceed through the steps prescribed by traditional instructional design models (e.g. Dick and Carey, 1990) in a linear fashion; however, we addressed most of the questions posed by the model. 2) We found our emphasis shifted from the procedures of instructional design to the process involved in making the decisions that guided the development process. 3) Rather than following a step-by step progression in our decision making, we addressed the questions of design in a spiral fashion, progressing through a series of steps at one level, then spiraling back and adding more detail within. Just as constructivist teachers believe that "knowledge is constructed by learners as they attempt to make sense of their experiences" (Driscoll, 1994, p. 360), these materials were constructed by the designers as they attempted to make sense of the information available: Initially, knowledge of the learners' characteristics, needs that existed in science methods instruction, the purpose of the instruction, and the environment in which the materials would be used, and later, the videotaped footage available.

The intent of this discussion was not to prescribe a set series of events that should occur in designing materials for use in a constructivist learning environment. Rather, we wanted to share our process in order to provide one experience that conveys the way the concept of "design" fits into developing such materials, to illustrate that decisions are not random, but proceed intentionally and purposefully, continually adding detail to prior layers. We also suggest that individuals trained in traditional instructional design methodologies can work in concert with constructivists to create materials in a purposeful manner. When designing materials to be used in constructivist learning environments, instructional designers should be guided by, but not limited by, the decisions required by traditional instructional design models. With a knowledge of the questions inherent in each stage of traditional instructional design models, designers can examine the data that evolve through the construction of instructional materials, and make decisions in collaboration with the client based on shared assumptions about the content and teaching/learning process. We hope this discussion of our experiences will inform instructional designers trained in traditional instructional design models of ways to adapt their training to the altered requirements of designing instruction in a manner consistent with constructivist theory.

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Title:

Information Processing Strategies Used in Learning from Video

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Information Processing Strategies Used in Learning from Video

Research on the manner in which learners process text materials has allowed the development of a rather comprehensive theory of text processing; however, there is less information available on how learners process information presented through television or videotape (1).

Videotape differs from text in several ways. Kozma (1) distinguished among various type of media in terms of their symbol systems, processing capabilities, and technology. The technology of text and videotape affect learning only to the extent that access to information present on videotape is limited to locations where a videotape playback machine and monitor are present, whereas access to text is much less restricted by location. However, the symbol systems and processing capabilities of the two media may affect the nature of the information gained and the way the information is processed. Text presents verbal information through printed words and uses pictures, diagrams and other representational symbol systems to present visual information. With videotape, the verbal information primarily is presented orally. Pictures and other representational images often depict motion and are usually presented simultaneously with the verbal information. Text allows the reader to access the information at random, but videotapes present information in a constant stream of auditory sounds and visual motion. Videotapes present information in a linear format, progressing without pause between the beginning and end of the program.

The technology, symbol systems, and processing capabilities of a medium interact to provide unique opportunities for information access. For example, I may be able to view a videotape demonstrating how to change a tire on a car in my home prior to attempting the task. The videotaped demonstration would allow me to see the specific items and procedures referred to by the verbal information. As such, I may be able to better "understand" the specific steps involved in changing a tire. I can see the results of improper actions at various stages in the process. However, due to the nature of the technology, I can not take the videotape with me to the location where I want to change a tire. With text-based information on the same topic, I am able to use the materials as a reference source while performing the task of changing my tire. The symbol system are limited to the printed word and still pictures, and I am not able to see the steps performed by another person. However, due to the random access provided by text, I am able to quickly locate references to specific steps where I may need additional information.

Role of Prior Knowledge

These differences in the processing capabilities of text and video may be especially acute for learners with prior knowledge of the content. Perhaps users have changed tires on other automobiles. They may be familiar with the steps of removing the hub cap, removing the lug nuts, and so forth, but may have never used the particular type of jack that came with their cars. With text-based materials, they can quickly skip over the steps on which they need no more information and go rather directly to the information needed. Videotape does not provide such easy random access to specific information.

Given the differences in the ease with which learners may randomly access text and video-based information, it may be useful to look at how these capabilities are used by learners reading text. Bazerman (2) found that experts in the domain of physics searched the literature for new information to update their knowledge in a random manner, driven by "purpose laden schemata". The physics experts skimmed articles in their content area very quickly and randomly. Often they began reading the abstract or conclusion, and once they determined that the article was of personal value, they often skipped to certain sections. Their access to information was guided by their search for very specific information to complement their existing knowledge. They appeared to be seeking answers to very specific questions, seeking information that fit within their existing schemata of physics and the way research should be done. It is unlikely that novices would have been able to read articles reporting physics research in a similar way. Instead, it is likely that they would have needed to start at the beginning and carefully construct a mental model of the content in order to understand the message of the article.

It is obvious that text can be explored differently based on the prior knowledge that users bring to the reading task. Due to its stability, the reader has "random assess" to the information on the printed page. Although text information is primarily designed to be read in a linear sequence, the stability of text allows the users to access the information in a sequence of their own choosing. Yet even when reading in a linear sequence, the learners' prior knowledge may affect the way they process the information

Steinley (3) compared the processing styles of readers as they read passages on word games with which they were familiar (crossword puzzles) and unfamiliar (doublets). He asked them to compare crossword puzzles and doublets with word search games (with which they were familiar). Readers were instructed to pause at the end of each paragraph and note whether they were attempting to "comprehend" the information or "compare and contrast" the information with word search games. As predicted, readers spent more time comparing and contrasting crossword puzzles with word search games than in comparing and contrasting the unfamiliar game of doublets with word search games. Conversely, the researchers found that readers spent significantly more of their time trying to comprehend passages on the word game unfamiliar to them than on the word game familiar to them. As readers concentrated on comprehending unfamiliar topics, they based their selection of a comprehension strategy on limited background knowledge, the complexity of the game, or their lack of information necessary to compare or contrast the game with a more familiar game. When reading about the familiar topic of crossword puzzles, readers also indicated the use of a comprehension strategy fairly often, but provided much different reasons for doing so. When reading text on the familiar topic, they selected a comprehension strategy to attend to details, to orient themselves to the text passage, and when nothing in the paragraph was useful for comparisons.

Consistent with mental model theory, these findings suggests that learners build a mental model of new content from the bottom-up, while they process information on a familiar topic in a top-down manner, calling upon existing knowledge and modifying it as they attend to relevant new information (4). Whereas novices' knowledge is limited and organized around the explicit information presented, experts reorganize new information around principles and abstractions of their prior knowledge on the subject (5). The studies cited above suggest that learners with prior knowledge of a text topic may choose to access the information randomly or engage in actively comparing new information with their prior knowledge. However, due to the transient nature of information presented through videotape and the linear nature of the medium, learners may be unable to process video-based instruction in the same manner as they process text-based instruction.

Purpose of the Study

The purpose of this exploratory study was to examine the way that learners process videotaped materials on a familiar or unfamiliar topic as informed by text-based research. A variation of the think-aloud method of assessing cognitive processes was used to gain insight into the role of prior knowledge in learners' thoughts while viewing a videotape on the topic of instructional design. Sasse (6) suggested that a teach-back technique, where learners are asked to "teach" a subject to a new learner, may be an effective way to determine learners' mental models of a content area; thus, the teach-back method, in combination with think-aloud protocols, was used to assess the manner in which the content was incorporated with the learners' prior knowledge. It was expected that learners with prior knowledge of instructional design would make more comments that compared and contrasted the new information with their prior knowledge than those unfamiliar with the topic of the videotape.

Methods

Participants

The nine participants in this study were enrolled in a graduate class in video production at a large midwestern university. Participants were classified as experienced in instructional design or unfamiliar with the topic based on prior exposure to the topic of instructional design in coursework or practice. Students were asked whether they a) had ever taken a course in instructional design, b) had designed instructional materials, and c) were familiar with any instructional design models. Five students responded positively to at least one of these three questions, and four responded negatively. One student experienced in instructional design was dropped from the analysis due to technical problems in recording her responses, thus, the final sample consisted of four experienced participants and four participants unfamiliar with the topic.

Materials

The videotape used in this study described the development of a course using a model of instructional design unique to a particular organization. Although the steps in the design process are similar to those in the model(s) with which some of the participants were familiar, the steps were clustered differently and the tape used different terminology. None of the participants were familiar with the particular model of design presented in the videotape. The videotape provided a general overview of the components of the instructional design process and the people involved. The program then presented the details of each of the five stages in the instructional design model in sequence. The tape described the steps involved in each stage of design and the roles of the individuals involved in completing the steps. For the purposes of this research, the videotape was divided into six segments ranging in length from 1.5 to 4 minutes.

Data Collection

Think-aloud protocols have been used to examine the cognitive processing of experts and novices in problem solving tasks (7) and in research on learners' mental models (6). Thus we believed that the think-aloud method would allow us to determine the extent to which viewers of a videotape on a familiar or unfamiliar topic were attempting to comprehend new information in order to construct a mental model of the topic or compare and contrast the new information with their prior mental models. However, when processing text materials, readers are able to pause in their reading to orally express their ideas. Due to the continual pace of auditory and visual information presented via videotape, verbalizations during viewing are likely to interfere with attending to information at the pace at which it is presented. Although viewers could pause the videotape to verbalize their ideas, we felt the freedom to pause the videotape to "think-aloud" about it's content would provide viewer control of the pace of information presentation and represent an artificial manipulation of the typical videotaped or televised presentation. Thus, in this study, the viewers were asked to "think-aloud" at the end of each of the six subsections in the videotape.

At the end of each subsection (ranging in length from 1.5 to 4 minutes), the interviewer stopped the videotape and asked the participant to verbalize his or her thoughts during the previous section. The first section, which provided a general introduction to the instructional design model and personnel, was used for the participants to practice the think-aloud method. The think-aloud data consists of the verbalizations which followed the five remaining sections, corresponding to the five stages in the design model. The verbal data were audiotaped, coded by participant number, and transcribed for analysis.

A teach-back technique was used to assess the learners' understanding of the tape's content. At the end of the videotape, the participants were asked to "teach" the instructional design process, as presented in the videotape, to the interviewer. The verbal responses to the teach-back task were audiotaped, coded by participant number, and transcribed for analysis.

Procedures

Each participant met with the interviewer individually in a quiet room. All interactions were audiotaped. When the participant arrived, he or she was greeted by the interviewer, questioned on prior experience with instructional design and with this particular design model, and informed of the topic of the videotape and the task for the experimental session. They were told that, at the end of the program, they would be asked to teach the method of instructional design described in the videotape to the interviewer and informed that they could take written notes if desired. Participants were instructed in the think-aloud method. They were told that the interviewer would stop the videotape from time to time, and, at that time, they were to orally recall their thoughts during the previous section of the tape.

As the participants watched the videotape, the interviewer stopped the videotape at the end of each of the six sections and the participants orally reflected back on their thoughts during the previous section. The first section of the videotape was used to "practice" the think-back method, thus, no data was collected from this section. At the end of the videotape, the viewer was asked to describe any thoughts he or she had on the program as a whole, then asked to describe the model presented in the videotape as if he or she was teaching it to a classmate.

Data Analysis, Results, and Discussion

The think-aloud data and teach-back data were analyzed to determine differences between those familiar and unfamiliar with the topic. It should be noted that this was an exploratory study, thus no hypotheses were formally tested. Initially, overall frequencies and percentage scores of coded categories were tabulated for the think-aloud and teach-back data. Finally, the think-aloud and teach-back protocols were analyzed qualitatively to complement and inform the patterns discerned in the quantitative data.

Think-alouds

The coding of the think-alouds protocols followed the recommendations of Ericsson and Simon (7). The verbatim transcriptions of the think-aloud data were divided into statements representing complete thoughts. The statements from each participant were coded as to participant number then jumbled so that the interpretation of one idea was not influenced by the participant's prior statements. In order to develop coding categories, one researcher read the entire list of statements and looked for themes to emerge from the participants' verbalizations. She identified a set of seven coding categories. Statements seemed to refer to 1) the viewers' comprehension of the material, 2) positive evaluations of their comprehension, 3) negative evaluations of their comprehension, 4) the instructional design process, 5) the quality of the video, 6) distractive aspects of the video, and 7) other miscellaneous comments. Using this set of coding categories, two other researchers independently coded the statements into these categories. Both researchers then sorted the statements by coding category and examined the lists to determine if all of the statements coded into a particular category were of a similar nature. Following this self-check procedure, the two researchers compared their coding of each statement. Differences in coding were discussed until the researchers came to agreement. The majority of coding differences occurred due to the difficulty that the coders had in discriminating between statements belonging in the two categories of "distracted by visuals" and "quality of video". Due to difficulties in definitively placing certain statements into one of the two categories ("distracted by visuals" and "quality of video"), they were collapsed into one ("quality of video"). Definitions of the coding categories and example statements are presented in Figure 1:

Figure 1: Coding Categories for Think-aloud Protocol

Comprehension	statements reflect an attempt to comprehend the content of the program: *"They went over objectives, content, topic activities, scripts, budget, and then the design"*
Positive evaluations of comprehension	statements are positive affirmations of one's comprehension: *"It makes pretty good sense."*
Negative evaluations of comprehension	statements are negative comments on one's comprehension: *"It's confusing."*
Design	statements compare or contrast the information with prior knowledge of instructional design: *"They follow the instructional design process that I'm familiar with."*
Quality of video	statements comment on the quality of the visuals or audio: *"I thought they could have been a little more creative".* Some statements indicate the viewer was distracted by the visuals or audio: *"I was spending a lot of time looking at where people were in their office and where they were going next."*
Other	statements compare or contrast the information with other prior knowledge: *" Part of it I related to a class I'm taking right now where we're talking about reliability and validity."*

Following the coding of each statement, the percentage of statements falling in each category was calculated by group (experienced in instructional design and unfamiliar with the topic). As you will notice from Table 1, the mean percent of comments were very similar between the two groups in a number of coding categories. Participants who were experienced in instructional design (E) and those unfamiliar with the topic (U) had a similar percent of comments relating new information to their prior knowledge of design, relating new information to other prior knowledge, and negative evaluations of their comprehension. Those experienced in instructional design had a greater percentage of comments that positively evaluated their comprehension. There were greater differences in the percent of comments made in two other categories: Participants unfamiliar with the content made a greater percent of comments related to the quality of the video than those experienced in instructional design; however, experienced participants made a greater percent of comments indicating comprehension of the content than those who were unfamiliar with the topic of the videotape.

Table 1: Think-aloud task: between group percentages and standard deviations

Coded category	QV	C	D	N	P	O
Experienced						
X%	22.1	41	15	13	7	2
(SD)	(2.6)	(11)	(3)	(3)	(1)	(1)
Unfamiliar						
X%	53.4	15	14	12	1	4
(SD)	(5.8)	(0.5)	(3)	(3)	(1)	(1)

Note:				
	QV:	Quality of video	N:	Negative evaluations of comprehension
	C:	Comprehension	P:	Positive evaluations of comprehension
	D:	Design process	O:	Other statements

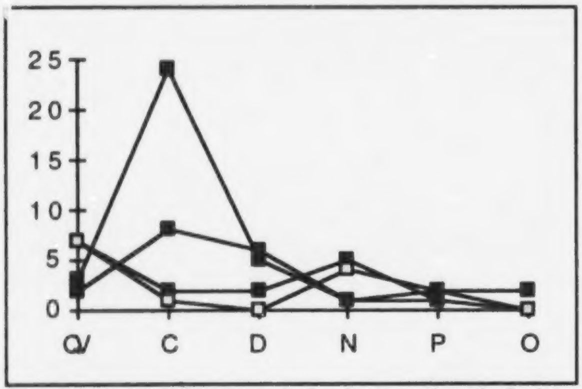
The similarities between the two groups in the percentage of comments comparing or contrasting the information in the tape with prior knowledge of design was surprising and prompted a review of the individual think-aloud protocols. Although the participants classified as unfamiliar with the topic of instructional design indicated that they had never had a course in the topic, had never designed instructional materials, and were not familiar with any instructional design models, their comments during the think-aloud protocols indicated that they were interpreting the content of the videotape relative to knowledge gained through other courses and work experience. The following comments from the protocols of those unfamiliar with the process of instructional design illustrate how they were attempting to relate the content of the videotape to their prior knowledge:

> *It's sort of the pattern we have learned in EDCI class, talking about the same things... whether it's feasible or not, the objectives, the outline, and that kind of stuff. So it's just like all those things that I already learned in that class.*
>
> *Like I said before, it's like may EDCI class. It's pretty much the same things that we're doing in our project. And I realized that I was thinking that right now we're about;to do the same things they're talking bout in our class projects.*
>
> *Well, again, that's getting to some material I already covered, but what I was thinking about was that I'm doing a project for one of my courses right now, developing instruction for a problem I have a t work and I was thinking when they were giving different drafts and so forth that this material... I guess.... and I guess I was thinking a lot of time looking at where people were in their office and where they were going next... and again, that could be because I've had this material before...*

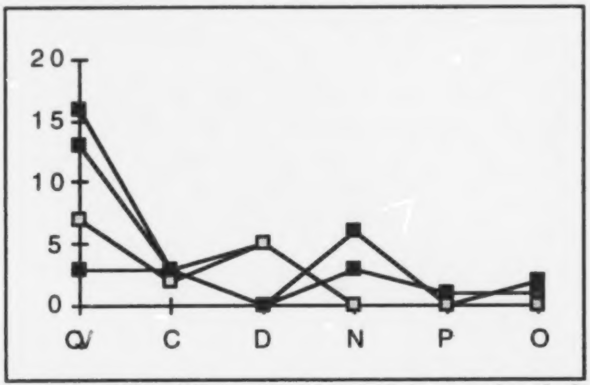
From these comments, it appears that the participants who indicated that they were unfamiliar with instructional design began to see the similarity between information they had been exposed to in other classes and the process of instructional design. It must be noted that all of the participants were involved in the pre-production planning stages of videotape production. Although they may have been unfamiliar with the term "instructional design", they began to see that they were familiar with some aspects of the process.

Within group variation, as indicated by the wide standard deviations in some categories, also prompted a closer examination of individual protocols. (see Figure 2).

Figure 2: Think aloud frequencies by group



Participants experienced in instructional design



Participants unfamiliar with topic of instructional design

Note: QV: Quality of video
C: Comprehension
D: Design process
N: Negative evaluations of comprehension
P: Positive evaluations of comprehension
O: Other statements

One designer had a large number of additional comments related to comprehension of the program. When examining his comments coded as "comprehension" in the context of adjacent comments, the vast majority of them were related to trying to understand how he would teach the material:

> *I was trying to get it down so I could reteach it. I was trying to get as much of it down as I could. I understand it. I understand it from what I've done, so I was mainly just focusing on getting the main points down.*
>
> *I was still trying to get all the parts down. All the different pieces of the puzzle, because it makes sense. It fits with what I already know.*
>
> *Generally, I was just trying to get it down and think about how I would present it.*

As this individual was a teacher and was told that he would be expected to teach the instructional design model to the interviewer after viewing the tape, it was not surprising that he was concentrating on comprehending the information in ways that would facilitate the teaching of the content.

In rereading the entire protocols for each individual, two of the experienced designers seemed very distracted by elements related to the design of the video:

> *There's a lot of audio.. just with all he's talking about... and he's going from scent to scene...*
>
> *Between those particular segments, I guess there was a lot of music. I tried to tune it out...."*
>
> *The whole time I was thinking this video could be seven or eight different videos... different one-hour videos..."*
>
> *When he was writing on the chalkboard... it was driving me nuts... I thought he should have had an overhead or something...*

All of those unfamiliar with the content of the videotape focused the majority of their comments on the quality of the videotape (two individuals in particular) as indicated in the following comments:

> *I actually lost track of him at one time.. I was looking at the light on the bald guy's head, thinking that they should have done the lighting different.."*
>
> *I actually didn't hear the first thing he was saying because I was thinking about the previous section, if those people were actors or the actual people like the writer, etc. and that's about all I was thinking about in that segment.*
>
> *I felt that there would have been a better way to do this, like with graphics and bullets or something... of course, this could be because of the course I'm taking in my video class... I think that putting things on the board took too much time, and I found myself watching him spell instead of listening...*

It appears that all participants were attempting to make sense of the content of the videotape relative to their prior knowledge. Those experienced in instructional design had the background necessary to "comprehend" the content of the tape. However, rather than focusing on the process of instructional design described in the tape, those unfamiliar with the process concentrated on evaluating the production values of the videotape. Although all the participants were enrolled in a course on videotape production and each participant possessed a similar awareness of good production techniques, those unfamiliar with the topic of instructional design may have been unable to build a coherent mental model of instructional design; thus, they may have reverted to interpreting the videotape based on their mental models of good video production techniques.

Teach-backs

Using a procedure described by Pask and Scott (8), the audiotaped teach-back protocols were transcribed and the statements were coded into categories used by Pask and Scott. Unlike the analysis of the think-aloud protocols which were coded as independent thoughts, the coding of the teach-back statements required an awareness of ideas that came before and after the statement to be coded.

Initially, statements were coded using Pask and Scott's categories (8); however, the need to modify the categories to encompass the data set soon became apparent. The final coding categories were determined though a review of the teach-back protocols to determine categories of responses. Two researchers, unaware of the group to which the participants belonged, independently read the protocols to determine trends in the data. Both researchers identified similar trends in the data, and coding categories were finalized. This analysis resulted in the elimination of certain categories used by Pask and Scott (8) and the subdividing of others. Both researchers then coded the teach-back protocols independently. Then, the two researchers compared their coding of each statement. Differences in coding were discussed until the researchers came to agreement. Definitions of the coding categories used in the final analysis and example statements are presented in Figure 3:

Figure 3: Coding Scheme for Teachbacks

Advance organizers	preview information to come: *"I can tell you of the overall design process from [lists steps]".*
Reviews or summaries	review or summarize previously presented information: *"Once you've established your objectives.."*
People	mentioned people from the videotape: *"there is the director for the program part of it.."*
Steps	mention steps in the instructional design process *"you're assessing your training needs."*
Other	recall other information directly from the tape (other than steps in the process or the people involved): *"... costs quite a bit of money and time".*
Elaborations	provide additional information on the people, steps, or other information derived from the tape: *"...they're the ones who actually do the testing"*
Inferences	derived from information stated in the tape or from prior knowledge: *"I call that the subject matter expert".*

Table 2: Teachback task: between group percentages and standard deviations

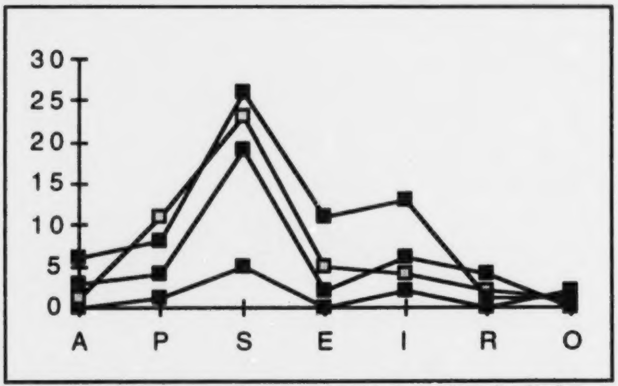
Coded category	A	P	S	E	I	R	O
Experienced							
X%	6.2	15	45	11	16	4	2.5
(SD)	(2.6)	(4.4)	(9)	(5)	(5)	(2)	(.08)
Unfamiliar							
X%	5.5	15	43	23	7	4	1.6
(SD)	(2.1)	(3.8)	(6)	(8)	(1)	(2)	(1)

Note:
A: Advance organizers
S: Step in design process
I: Inferences
O: Other information recalled
P: People mentioned in tape
E: Elaborations
R: Review or summary statements

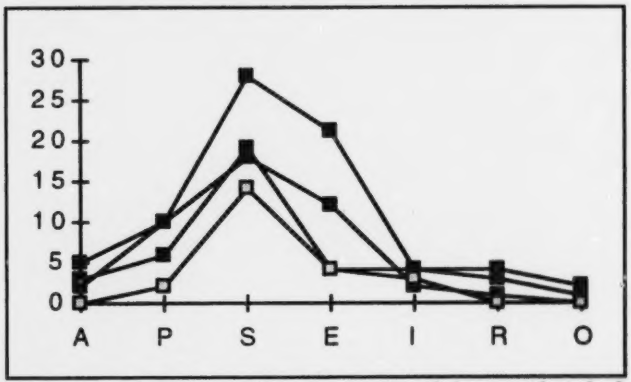
Following the coding of each statement, the percentage of statement falling in each category was calculated by group. As you will notice from Table 2, there was little difference in the percentage of comments coded as advance organizers , people mentioned , steps mentioned, review or summary statements, or other information recalled directly from the tape. However, participants who were unfamiliar with instructional design elaborated on the information recalled from the tape to a greater extent than those experienced in the process . Those experienced in instructional design expressed more inferences derived from the tape or prior knowledge than those unfamiliar with the process.

As indicated in Figure 4, there was less within group variation in the teach-back data. One individual in the group of experienced designers had fewer comments coded as "Steps" than the other three, and one participant unfamiliar with instructional design had more comments coded as "Steps" and "Elaborations" than the other three inexperienced participants.

Figure 4: Teach-back frequencies by group



Participants experienced in instructional design



Participants unfamiliar with the topic of instructional design

Note: A: Advance organizers
P: People mentioned in tape
S: Step in design process
E: Elaborations
I: Inferences
R: Review or summary statements
O: Other information recalled

In general, both groups mentioned a similar number of instructional design steps, people involved in the process, and other information stated in the tape. It must be noted that participants were encouraged to take notes to aid them in performing the teach-back task in order to replicate a natural setting in which an instructional videotape would be used. It is likely that the participants were guided by their notes when teaching the process back to the interviewer, thus, both groups recalled a similar number of steps, people, and other details from the tape. Both groups organized their teach-backs similarly, with both groups using a similar number of advanced organizers and review and summary statements.

However, when asked to teach the instructional design method to another person, there were differences in the way the two groups approached the task: those with experience in instructional design included a greater number of inferences derived from the tape or prior knowledge, while those unfamiliar with the process included a greater number of elaborations on the information recalled from the tape. Inferences reflected information not explicitly stated in the tape, but which could be derived from prior knowledge or by linking information in the tape in a new way. In the following examples, the segments coded as inferences could not have been derived from the content of the tape:

They call it the content person (coded as People). *I call that the subject matter expert* (coded as Inference)

....you actually do the production (coded as a Step) ... *This cost quite a bit of money here, too.* (coded as Inference).

The first area is to determine the feasibility (coded as a Step).... *I would imagine that's when you go into a needs analysis.* (coded as an Inference)

On the other hand, those unfamiliar with the process of instructional design included a greater number of elaborations in their teach-backs. Elaborations differed from inferences in that statements coded as elaborations expanded upon the information recalled from the tape. They offered additional details supporting the recall of steps, people, or other information presented in the tape. Consider the following segment from the teach-back protocols of inexperienced participants:

You're assessing your training needs- (coded as a Step)... *does it need to be done? I s the instructional design and development the right things to do based on the subject matter expert, background information.* (coded as an Elaboration)

Then it goes into development (coded as a Step) *where they go ahead and piece together everything, like it needs slides, video, music, anything like that they are going to need* (coded as Elaboration).

Then there's the design report (coded as a Step) *so that it actually includes the blueprint and just summarizes all these little aspects* (coded as Elaboration).

The analysis of the teach-back protocols suggests that experienced participants may have been able to built from prior experience to generate inferences during the teach-back sessions; however, participants unfamiliar with the topic of instructional design may have used the opportunity to teach-back the topic presented in the videotape to further process the information as they explained it to the interviewer through elaborating on the topics as they spoke.

Conclusion

Based on the research conducted with text, we expected that those familiar with the topic of the videotape would compare and contrast the new information with their prior knowledge as they viewed the videotape. We expected them to seek answers to questions that they had about the process of instructional design specific to this particular organization in order to modify their existing mental models of the topic. Conversely, we expected those unfamiliar with the topic to concentrate on comprehending the information in order to build a mental model of the content.

The data from the think-aloud protocols suggest that all participants were attempting to relate the new information presented via videotape to topics with which they were familiar. While those with experience in instructional design did compare the new information to their prior knowledge of the topic, those unfamiliar with the topic appeared to be relating the steps in the instructional design process to the steps in planning for a videotape production. Comments such as "this is like what we're doing in my education class " were common.

In addition, all of those unfamiliar with the topic and half of those with experience in instructional design were frequently evaluating the production of the videotape while viewing the program. As an exploratory study, this investigation was limited by the fact that all participants were enrolled in a course which offered them the knowledge needed to critically examine the production of the videotape. However, these statements provide further evidence that the viewers relied on knowledge gained in other contexts to interpret what they saw in the videotape.

Analysis of the teach-back protocols provided additional information on the cognitive processing of the videotaped information. Participants with experience in instructional design included a greater percentage of inferences which linked the content of the videotape with other related ideas; participants unfamiliar with the topic included a greater percentage of comments that elaborated on the content of the tape. The nature of the comments coded as inferences suggests that the experienced participants may have stored the new information with their prior knowledge of instructional design, and thus, as they recalled the information from the tape, they also recalled other related ideas. The nature of the comments coded as elaborations suggests that those unfamiliar with the topic of the videotape may have continued to process the content of the tape during the teach-back sessions, mentally organizing the information as they elaborated on the content and added details to the steps recalled from the tape.

As an exploratory study, the results of this investigation provide evidence that the think-aloud and teach-back methods can be used successfully to gain insight into the cognitive processing of videotaped materials. Prior to this study, no published studies reported using the think-aloud or teach-back method to collect data on viewers' cognitive processing. The think-aloud protocols seemed to reasonably represent the viewers' thoughts during the program. Future studies using similar procedures should collect student notes to complement the oral data. In addition, the teach-back method seemed to provide further information on the learners' cognitive processing of the information presented via videotape. Future research should continue to examine the relationship between learners' prior knowledge of the content of a videotaped presentation and the way they process the information presented though this linear, transient medium.

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Title:

An Analysis of the Knowledge Levels of Media Directors Concerning Relevant Copyright Issues in Higher Education

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General Method

This study analyzed the copyright knowledge levels of media directors of selected higher education institutions. The study determined their overall knowledge level of the 1976 Copyright Act by questioning the media directors with respect to specific areas of the law that are pertinent to their responsibilities. These specific areas included Sections 106 (Exclusive Rights), 107 (Limitations on Exclusive Rights: Fair Use), 110 (Limitations on Exclusive Rights: Exemption of Certain Public Performances), and the guidelines that cover classroom materials taken from books and periodicals, music, and off-air videotaping. Information on demographics was also collected. In addition, follow-up telephone interviews were conducted with a random sample of 10% of the respondents.

Research Population

The population consisted of members of the Division of Educational Media Management in the Association for Educational Communications and Technology (AECT) who are employed at institutions of higher education and other members of AECT who indicated in the directory that they have some media responsibilities at higher educational institutions. The 1993 AECT Membership Directory was used to identify members of the population. Several criteria were used to determine if a subject was a potential member of the population. These included the subject's position title. Members of the sample group who were chosen had titles of media director, media specialist, head of audio-visual, director of learning resources, or similar variations, at higher educational institutions. The AECT directory provides two other alternatives to locating population members. The first is the division affiliation of each member. The Division of Educational Media Management (DEMM) primarily contains educational media directors. However, some members of DEMM are involved in K-12 management. Subjects who indicated that they were members of DEMM and worked at higher educational institutions were considered to be members of the sample group. Finally, many AECT members list professional descriptions with their address (i.e. Teacher/Professor, Librarian, Instructional Designer, etc.) Those individuals who indicated that they were an AV director or media specialist at a higher educational institution were also included. A total of 466 subjects, nationwide, were identified as being probable members of the population due to their position titles or their affiliations within the organization. Even with the detailed and individual selection of population members, it was expected that a minor percentage of those identified may be eliminated later, because they are not media professionals at a higher educational institution. This anticipated reduction in the number of members of the population was taken into account when determining the sample size.

The cover letter included with the mailed instrument identified the population and asked participants to complete the survey only if they were members of the population. Demographic questions on the survey were alsoused to screen respondents who were not part of the population.

Specific Procedures

Each of the 466 members of the sample population were mailed the questionnaire. Members of the sample group were mailed a questionnaire (multiple choice test) that asked specific questions concerning the Copyright Law of 1976. In addition, a cover-letter describing the study, and a self addressed stamped envelope accompanied the questionnaire. The return envelopes were coded to determine who had responded. A follow-up mailing to those who did not respond to the first mailing took place one month after the initial mailing. Respondents' answers to the instrument remained anonymous. Answers on the returned questionnaire were transferred to a tabulation sheet.

After both mailings were complete, follow-up telephone interviews were conducted with a random sample of 10% of the respondents. Selection of this sample was done by using the numbers assigned to each member of the poplation from the original mailing. Using a random number table, numbers were selected. If that number corresponds to a member of the population who responded to the questionaire, they were included in the interview. Selection continued until 10% of the respondents had been selected. If the interviewer was not able to reach the selected respondent after a reasonable period of time due to any variety of uncontrollable reasons, new random numbers were generated to replace those respondents who could not be reached by telephone. This process continued until the number of interviews reached 10% of the respondent population. Responses to the interview questions were recorded by the interviewer on paper. Each interview resulted in manual notations made on questionnaire sheets similar to Appendix C.

Instrumentation

The instrument used was an adaptation of the instrument used in the previous two studies (Wertz, 1984; Chase, 1993). The questions used compose a test concerning three sections of the Copyright Act of 1976 (Sections 106, 107 and 110) and the related guidelines (print materials, music, and off-air recordings). Eight questions were removed from the original instrument. These questions all dealt with Section 108 (Limitation on exclusive rights: Reproduction by libraries and archives) and the guidelines for photocopying/ interlibrary loan arrangements. The remaining questions were rewritten and expanded in an attempt to make clear the intent of the query. All of these questions are multiple choice with only one correct response. Great effort has been taken to clear any ambiguity that could have arisen from any of the questions. Each question and correct response comes directly from the law or the related guidelines. In addition, questions concerning demographic data were added to the beginning of the questionnaire, and a space for general comments was added at the end.

Pilot Study

A pilot study was conducted using the questionnaire. Volunteers were solicited from the Media-L Listserv and the CCUMC (Consortium of College and University Media Centers) Listserv on the Internet. These lists are groups of media professionals who exchange information via the Internet. A message was sent to each group asking for help from media directors at higher educational institutions who were not members of AECT. A total of twenty two directors responded to the request for assistance. The questionnaire was then transmitted by facsimile to the twenty two who indicated an interest. Their responses were then returned by facsimile. Twenty professionals provided responses and comments. As a direct result of their comments, some minor changes and revisions were made to the instrument. The survey responses were tabulated, and the Office of Measurement and Evaluation at the University of Pittsburgh provided an analysis to determine the reliability of the instrument. Using the Kuder-Richardson 20 formula to determine reliability, a score of .74 was achieved. As a self developed instrument, it was deemed reliable.

Treatment of the Data

Returned responses from the study were tabulated, and the total percentage of correct responses for each respondent was determined. A total correct percentage score of 75% was used as the criterion to determine a proficient knowledge level. This proficiency level is consistent with the previous studies (Wertz, 1984; Chase, 1993). The total number of respondents who achieved the 75% proficiency level was determined. The number of proficient respondents was divided by the total number of respondents to determine the final percentage of proficient respondents.

Additional analysis took place by examining the six areas on which the questionnaire focuses (Sections 106, 107, 110 & guidelines for classroom materials, music, and off-air recordings). Scores were calculated that showed the percentage of group members who reached the 75% proficiency performance in each particular section. All of these percentage scores were contrasted to the percentage results of the previous studies (Wertz, 1984; Chase, 1989).

The demographic data collected was also examined. Each of the four questions at the beginning of the survey was used to further interpret the results.

The first question concerns the position title and provides for a response of: a) media director/ media specialist/ AV director, b) librarian, c) faculty, or d) other (please explain). While one of the primary reasons for this question was to ensure that respondents were members of the population, the other was to attempt to establish the breakdown of media professionals who saw themselves as media librarians vs. media "non-librarians."

The second demographic question deals with the respondent's total number of years experience as a media professional. The possible responses include: a) 0-5 years, b) 6-15 years, c) 16-25 years, or d) 25 or more years. This question helped to determine if new members of the field are better prepared to deal with copyright questions than established members. In contrast, it attempted to show that those who have been in the field for a number of years appear to be more competent when dealing with copyright related issues.

Level of education is the third portion of the demographic data collected. Possible responses include a) bachelor's degree, b) MLS master's degree, c) other master's degree, or d) doctoral degree. Two primary questions were evaluated with this question. First, did a terminal degree in the field translate into a better understanding of copyright issues? The second question deals again with the librarian vs. non-librarian relationship. Are the MLS professionals perhaps the best prepared of all the media professionals when it comes to copyright?

The final question deals with the size of the academic institution where the respondent works. The possible options include: a) under 5000, b) 5000-10,000, c) 10,000 - 20,000, or d) over 20,000. What impact did the size of the institution have on director's knowledge level of copyright? Do members of large institutions have a more in depth knowledge of copyright or are there specialists on campus who relieve them of that responsibility?

Once all the data was collected, an evaluation was made to determine the results. The first evaluation examined all of the respondents who achieved or exceeded the 75% criterion. The demographic responses of only the proficient group were tabulated and contrasted.

The second evaluation examined the percentage of respondents who reached the proficient state in each of the six divisions. These scores are contrasted to the scores of the 1984 and 1993 study.

Finally, a Chi-square test was used to examine the relationship between demographic characteristics and proficiency. Each of the four demographic areas were tested in an attempt to identify significant scores in any particular group. This was done by comparing expected percentages of proficient respondents to actual percentage of proficient respondents to each of the four demographic responses. The final result produced a statistical table for each of the four demographic questions. Each table shows the percentage of proficient and non-proficient respondents within each of the possible four choices in the demographic question. This test was extended by cross tabulating the six areas of the law, demographics, and proficiency to determine levels of significance.

Questionnaire Responses

On May 13, 1994, 466 copies of the questionnaire (Appendix A) along with a cover letter (Appendix B) and a self-addressed, stamped envelope were mailed to identified AECT members. On June 15, 1994, 266 follow-up letters with another copy of the questionnaire and another self-addressed, stamped envelope were mailed to those individuals who had not yet responded. By July 15, 1994, two hundred members had responded by completing the questionnaire. Forty-five others had mailed back the cover letter indicating that they were not part of the population. Seven individuals indicated that they did not wish to participate. Seven letters were returned by the post office as "undeliverable," and one member of the population died.

Survey Results

The responses to all the survey questions were compiled and analyzed. The reliability of the instrument was again calculated. Using the Kuder-Richardson 20 formula, a score of .79 was realized. The instrument was again deemed reliable.

The mean score of the respondents on the instrument was 58.6%. Eighteen percent (or 36) of respondents scored 75% or higher on the instrument. This contrasts to 15% in the 1984 study and 10% in the 1993 study. A complete breakdown of percentages of respondents who reached the proficient state of 75% or higher in each of the different instrument sections is shown in Table 1.

The section with highest percentage of respondents reaching the proficient state was the Guidelines for Off-Air Videotaping with 62%. The section with the lowest percentage of respondents reaching the proficient state was Section 110 (Limitations on Exclusive Rights: Exemptions of Certain Performances and Displays) with only 26%. Three of the sections showed higher percentages than either of the previous two studies. These included Section 106 (Exclusive Rights), Section 110, and the Guidelines for Classroom Copying with Respect to Books and Periodicals. Only Section 107 (Limitations on Exclusive Rights: Fair Use) showed a lower percentage than the previous two studies. Two of the sections showed mixed results with the percentages falling between the previous two studies. These included the Guidelines for Classroom Use of Music and the Guidelines for Off-Air Recording of Broadcast Programming for Educational Purposes.

Table 1

Percentage of Respondents Who Reached the Proficient State in Each Division

Area of Copyright Law	% in 1984 Study (n=144)	% in 1993 Study using 1984 instrument (N=93)	% in 1994 Study using revised instrument (n=200)
Section 106 Exclusive Rights	47% (n=68)	53% (n=49)	61% (n=122)
Section 107 Fair Use	71% (n=102)	66% (n=61)	56% (n=112)
Section 110 Public Performance	11% (n=16)	8% (n=7)	26% (n=52)
Classroom Guidelines	23% (n=33)	14% (n=13)	31% (n=62)
Music Guidelines	32% (n=46)	25% (n=23)	28% (n=56)
Off-Air Videotaping Guidelines	59% (n=85)	74% (n=69)	62% (n=124)
All sections	15% (n=21)	10% (n=9)	18% (n=36)

Table 2

Number of Proficient Respondents Separated by Demographic Responses

Question	Responses			
Position	(media director) 30	(librarian) 1	(faculty) 0	(other) 5
Years in Profession	(0-5 years) 2	(6-15 years) 14	(16-25 years) 18	(25 or more) 2
Highest Degree Earned	(bachelor's) 2	(MLS) 3	(master's) 18	(doctoral) 13
Size of Institution	(<5000) 13	(5-10,000) 9	(10-20,000) 6	(>20,000) 8
				(n=36)

Table 2 shows the breakdown of how the proficient respondents answered the demographic questions. A total of 36 respondents scored 75% or higher on the survey. The proficent respondents' demographic responses are indicated below. Each row of responses will total 36 for the number of proficient respondents. It should be noted that each column did not have an equal number of respondents.

Further evaluation was done on the demographic data in an attempt to identify significant differences. A Chi-Square analysis was done to cross tabluate each of the demographic data areas with proficiency. A significance level of .05 was used to interpret the results. Tables 3 through 6 show the results of that analysis.

Table 3

Cross Tabulation of Position Title with Proficiency

Response	Proficient *fo* *(fe)*	Not Proficient *fo* *(fe)*
media director	30 (29.3)	133 (133.7)
librarian	1 (1.3)	6 (5.7)
faculty	0 (.9)	5 (4.1)
other	5 (4.5)	20 (20.5)
fo = frequency observed *fe = frequency expected*		n = 200 X^2 = .74131

Table 4

Cross Tabulation of Years of Experience with Proficiency

Response	Proficient *fo* *(fe)*	Not Proficient *fo* *(fe)*
0 - 5	2 (4.1)	21 (18.9)
6 - 15	14 (15.3)	71 (69.7)
16 - 25	18 (13.0)	54 (59.0)
25 or more	2 (3.6)	18 (16.4)
fo = frequency observed *fe = frequency expected*		n = 200 X^2= .19176

Table 5

Cross Tabulation of Highest Level of Education with Proficiency

Response	Proficient *fo* *(fe)*	Not Proficient *fo* *(fe)*
bachelor's	2 (3.9)	20 (18.1)
MLS	3 (3.7)	18 (17.3)
other master's	17 (17.2)	80 (79.8)
doctoral	13 (10.1)	44 (46.9)
fo = frequency observed *fe = frequency expected*	n = 197* X^2= .51202 * 3 responses could not be used	

Table 6

Cross Tabulation of Institution Full Time Enrollment (FTE) with Proficiency

FTE	Proficient *fo* *(fe)*	Not Proficient *fo* *(fe)*
< 5000	13 (12.8)	58 (58.2)
5000 - 10,000	9 (7.9)	35 (36.1)
10,000 - 20,000	6 (7.2)	34 (32.8)
> 20,000	8 (8.1)	37 (36.9)
fo = frequency observed *fe = frequency expected*	n = 200 X^2= .93406	

Each of the four cross tabulations showed a level of significance of >.05. Therefore, the number of proficient and non-proficient respondents in each of the demographic categories can be considered not significant. None of the areas showed an unusually high or low number of respondents.

Each of the six areas of the law were also contrasted with the demographic data in relationship to proficiency. The respondents who reached the criterion level of proficiency in the specific section were contrasted with their demographic responses. Only one section showed a level of significance < .05. Table 7 shows the analysis for the cross tabulation of the full time enrollment on Section 107 and proficiency.

Table 7

Cross Tabulation of Full Time Enrollment by Section 107 with Proficiency

Response	Proficient *fo* *(fe)*	Not Proficient *fo* *(fe)*
< 5000	43 (39.4)	28 (31.6)
5000 - 10,000	16 (24.4)	28 (19.6)
10,000 - 20,000	25 (22.2)	15 (17.8)
> 20,000	27 (25.0)	18 (20.0)
fo = frequency observed *fe = frequency expected*		n = 200 X^2= .03802

It can be determined that there are some significant differences in the results of Table 7. Most notably is the poor performance by members of the 5000 - 10,000 group, who showed only 16 proficient members when questioned about Section 107 (fair use). The other three groups all showed a higher than anticipated number of proficient respondents.

At the end of the survey a place was provided for comments. Almost a third of the respondents chose to make comments concerning the study or on copyright in general. The comments ranged from general observations about copyright to specific requests for information. Many people asked for a copy of the findings, the correct answers, or suggestions of good reference materials dealing with copyright. Many of these requests have been filled. However, the responses were blind, and if the respondent did not provide an address or name, it was impossible to do so. Others requested that the results be posted on the Internet for review.

Several comments were made concerning multimedia, computer software, and distance learning issues and their noted absence in the survey. A number of people also noted that some of the subject areas were not relevant to their job area. As a result, these people were also concerned that their scores would not represent their actual copyright knowledge level within their position.

A few people critiqued the methodology of the study asking if the questions would really provide any answers. Two individuals noted that this was an exam not a survey or complained about the length and depth of the quesionaire. One director's response summed up the negative comments:

> This is much more of a quiz on whether the reader did his or her reading assignment than it is an attempt to survey the working knowledge of practioners. You've been taking graduate courses too long. You haven't
>
> found our how "knowledgeable I am about . . ." You found out how good I am at taking a confusing quiz.

These sentiments were not shown by the majority of respondents. Many of the comments were positive and noted the importance of copyright in the profession. Some members applauded the effort to do research on such a timely and controversial topic. Others mentioned that after attempting to answer the questions that they realized they weren't as familiar with the law as they thought they were. One respondent commented that copyright needed to be included in education methods courses and not left only to media professionals.

Follow-up Interviews

During the last two weeks in July, follow-up interviews were conducted with a random sample of 10% of the respondents. During the interview process, it was necessary to replace four members of the interview group. Two members could not be reached. One member was on extended leave, and the fourth was no longer with the institution. Their replacements were selected using the same process as the initial selections.

Each interview began with an introduction refreshing their memory about the study and a reminder that all of their responses would remain anonymous. The first question determined if they felt the questions provided an accurate measurement of their copyright knowledge. Fourteen of the twenty subjects indicated that they thought the questions provided an accurate measurement of their copyright knowledge. Some members commented that they felt the questions were "broad based" and "appropriate," although others who answered yes also noted that some of the questions were not related to their specific work. While one subject could not recall the questions, five indicated that they did not feel the questions provided an accurate measurement. Their comments noted that: they knew more than they were asked, they were unhappy with the question structure, they felt the questions were somewhat skewed and did not show enough concern for multimedia applications, or that their position dealt primarily with print materials and the majority of the questions were inappropriate.

The second question determined if there were areas of the law that should have been added or removed from the questionnaire. None of the subjects mentioned any areas that they thought should be removed. There were a number of suggestions for additions. Three members indicated multimedia should have been included. Two members noted computer software and distance education issues. Other topics discussed the inclusion of more on print materials, suggested guidelines, videotaping, format shifting, new media, and fair use material.

Question number three wanted to know if the questions on the instrument were, or were not, relevant to their job at the institution. Two of the subjects indicated that most of the material was irrelevant to their job. The music guidelines and the print guidelines, each received five votes as irrelevant. Off-air videotaping was also mentioned once as not being relevant. The remainder did not provide a response.

The fourth question attempted to discover how much help participants were getting in answering the questions. Did they use any reference materials or seek assistance in answering any of the questions? If they did, from what sources and how much? Four of the interviewees indicated that they did use some materials in answering the questions. Two of them noted that they had a copy of the law and referred to it. One mentioned a publication by Gary Becker entitled © Copyright: A Guide to Information and Resources and another mentioned a a publication by AIME entitled A Viewer's Guide to the Copyright Law: What Every School, College, and Public Library Should Know.

Question number five inquired into the subjects' background, and where and how they had obtained their copyright training. Professional journals was the most often cited source with ten members mentioning them. Nine subjects indicated that they had attended a seminar or workshop on copyright. Seven indicated that they had attended at least one session at the AECT national conference that related to copyright. Seven also mentioned books and publications that they had read to gain experience. Three indicated that their formal higher education had included copyright issues as part of the course work. Two mentioned the Internet and listservs as a source for information, and finally one had watched a teleconference on copyright issues in education.

The sixth question was a broad question asking what should a media professional know about copyright. The most common and flippant answer was "as much as possible," but many went on to cite specific areas. These included the guidelines (3 members), computer software (4 members), distance learning (3 members), duplication of materials (2 members), and fair use (3 members). The rest of the answers were a hodgepodge of suggestions and insights. These included: how to reach faculty with copyright information, what was permissible, how to stay out of trouble, ability to clearly explain the law, be too conservative, know the current issues, know what faculty can and can't do, have access to legal help, know who the definitive resource is on your campus, and applications to student projects. One member summed up the question by stating that we simply need for a code of ethics in our profession and for media professionals to use it in their work.

The seventh question attempted to gain insight on how the administration at each institution regarded copyright issues. Twelve of those people interviewed described their administration as viewing copyright as an important or very important issue. Two people described their actions as very good on computer software issues, but nonexistent for other non-print media. Four people said their institution tended to ignore copyright issues, and two described their institution as ambivalent.

Question number eight provided the members an opportunity to comment on AECT's effort to provide copyright information. Seventeen of the interviewees reacted positively noting the publications and efforts of the Association. One described their efforts as acceptable, while one claimed they had not seen much from AECT. Another interviewee described their efforts negatively. They described a recent copyright initiative with CCUMC that the copyright committee of AECT had pledged to support and then had not followed through.

The ninth question was concerned with how media professionals could best provide copyright information to other media professionals. Eight members mentioned professional journals as an avenue for the distribution on information. Six noted the Internet, with some suggesting a listserv for copyright issues. Print materials for distribution were mentioned by five respondents. Four listed workshops or conferences as one of the best ways to get the word out. Two people mentioned the possibility of teleconferences, and one suggested a videotape for distribution. Another insisted that copyright needs to be part of every related academic program and taught accordingly. Finally, one member suggested the best way was by setting a good example.

The final question provided an opportunity for any final comments that professionals wanted to make about the study or about copyright in education. Some who responded directly about the study mentioned that they felt the study was either important, valuable or worthwhile and appreciated someone doing the research. Two asked specifically to be sent the results, while one mentioned that they were fearful of the results. One suggested that the study should have been more flexible allowing greater leniency to members in areas that were not appropriate to their work.

With regard to copyright in general, two members mentioned the difficulty of the copyright issues surrounded new technologies in multimedia, distance learning, and electronic publishing. One interviewee discussed the difficulty of reaching the faculty and educating them to the importance of copyright.

Discussion & Findings

As predicted, a small percentage of media directors were able to reach the proficiency level of 75%. Only 18% (as compared to 15% in the 1984 study) were able to do so. This despite efforts to revise the instrument to make it more readable and the elimination of two sections considered irrelevant to the work of many media directors. The mean score for the respondents was computed at 58.6%, demonstrating that the directors did seem to at least have some background in copyright. This is higher than the mean score from the 1993 study which was 56.6% (The mean score from the 1984 study is not available). If, as suggested by some respondents, there had been a response of "not applicable" for those questions that were not relevant to the subject's work, we could have expected the number of proficient subjects and the mean scores to rise.

The survey method of data collection must be scrutinized when reviewing the results. The system developed to survey the directors leaves some degree of ambiguity in interpreting the results, regardless of how carefully it was administered. The attempt of the study was to identify the level of knowledge that directors had and use in their work environment. It was anticipated that some directors would use reference materials or seek assistance in answering the questions. The cover letter spoke directly to this by stating "provide responses to these questions using the same procedure as you would under normal working conditions." If reference materials or subject experts were available and regularly used by the professional, then they should be available for use in answering the survey. The objective was not to test the subject's memorization but to determine the quality of "working" information that directors were providing to their faculty and staff. The mailed survey can only give one perspective of this knowledge level. Other instruments may identify different percentages, but it is predicted that those percentages would not deviate significantly from the results of this study.

During the follow-up interviews, 20% of the directors indicated that they sought assistance in answering the questions. Though the possibility of more respondents examination of the copyright law and its guidelines might exist in their attempt at answering the questionaire. The researcher considered these respondents' efforts in this respect as a positive sincere attempt on their part at finding out what the law and its guidelines provide in answers to the questions at hand. The figure of 20% is surprisingly close to the percentage of proficient respondents. The correlation of the two was not examined, but future studies might find a relationship. Perhaps one of the major outcomes of this study may be that many directors locate and use reference materials. A number of people commented at the end of the questionnaire that they were not as familiar with the law as they thought, or that they needed to review some of the materials. Several respondents asked about a definitive resource for copyright issues in education. Suggestions were mailed back to those who requested the information.

The increase in the total proficiency of the group to 18%, while still low, is an encouraging sign. The trend is moving in a positive direction toward a more informed group. The current study had over 200 respondents, almost twice the number of the previous studies. The survey provided language that worked toward discovering the respondent's real knowledge level and not their ability to decipher the question. However, there was still criticism from the respondents concerning the difficulty and apparent trivial nature of some of the questions.

The individual section scores showed some interesting trends. Sections 106, 110, and the classroom print guidelines all showed the highest percentage of proficient respondents of the three studies. Copyright continues to be an issue discussed regularly at professional association meetings and in professional publications. This awareness may have partially manifested itself in an understanding of the basic rights of a copyholder (Section 106). This would explain the percentage rise for Section 106. The rise in Section 110 is probably primarily related to the rewording of some of the questions from this area. Those questions in particular were difficult to read because of the legal language. The restructured questions perhaps gave a better insight into the actual understanding of the Section by the directors. Another explanation for the increase could be the recent reexamination of the Section given the new issues arising in distance education. Debate continues on the merits of public performance exemptions on distance learning applications. These issues may have aided in supplementing the professionals knowledge of this area of the law. The classroom guidelines for print materials also saw its highest percentage of proficient respondents. No specific event can be attributed to this increase. However, some of these questions were also rewritten, and perhaps the attention generated by the recent Kinko's case has brought additional awareness to these issues.

The decrease of proficiency in Section 107 (fair use) is the most intriguing of the results and may be the most difficult to specifically explain. The other two sections of the 1976 law both showed increases in the percentage of proficient respondents. Fair use continues to be one of the most misunderstood and misinterpreted portions of the law (Sinofsky, 1984). This is one of the areas where only a little knowledge can be damaging, since a number of variables impact on fair use interpretations. While the majority (88%) understood that fair use was applicable to teaching, news reporting and criticism, only 36% knew that the medium was not a factor when determining fair use. When asked what the key to the purpose and character of fair use was, 63% were able to identify the correct response "for non-profit educational purposes." Seventy-five percent identified the effect of the use of a copyrighted work upon the potential market as a "major consideration." Based on these responses it would appear that many are familiar with fair use, but could not accurately identify and evaluate specific applications using the four criteria for fair use. This is a difficult area of the law for media directors and is the one area that specifically shows the need for additional instruction. Many directors are quick to claim an understanding of fair use, but few can probably recall the four criteria for the application of fair use.

Both the Music and Off-Air Videotaping Guidelines received mixed results. Their percentages fell between the previous two studies. Several of the respondents noted that one or both of these areas were not applicable to their work. It should be noted that 17% of the respondents did not answer each of two of the music questions. Changes in technology have also complicated the issues of videotaping programs. Many directors (33.5%) did not understand that cable television programming is not covered by the off-air guidelines. Additional instruction is required for both areas.

The attempt to cross tabulate the demographic statistics with proficiency provided no significant findings. The first statistic involved the analysis of position and proficiency. As discussed earlier, this question was primarily a filter to eliminate respondents who were not part of the population. One respondent was eliminated when she indicated she was a media professional for a secondary school district. The media director/specialist choice was selected by 81.5% of the respondents. It was therefore difficult to draw any conclusions due to the low number of responses for the other choices. The Chi-square analysis found no significant difference in the number of proficiencies in each of the selections.

The cross tabulation of years in the profession with proficiency showed no significance at the .05 level, but it was interesting to note which group had the highest number of proficient respondents. The group who had been employed 16 - 25 years composed 36% of the total group, yet they were 50% of the total number of proficient subjects. The X^2 was .19 meaning that statistically this could have happened by chance, but future studies may examine this area and find a discrepancy.

The last two cross tabulations with total proficiency (highest degree earned and size of institution) showed no irregularities. Their X^2 s were .51 and .93 indicating that the results are consistent with the population.

The only significant result was found when the six individual sections of the copyright law were cross tabulated with the demographics and section proficiency. When full time enrollment and Section 107 (fair use) were analyzed with the proficiency levels, the level of significance was only .03. Members who worked at institutions that had a full time enrollment of 5000 - 10,000 scored significantly lower than anticipated. It is difficult to explain the poor performance of this specific group since their overall proficiency level was not below expectations. There are misconceptions concerning the understanding and applications of fair use as discussed earlier and in chapter two. This group appears more confused on this issue than most, and probably doesn't have legal counsel on campus to provide regular interpretations. They are apt to be making fair use judgement at their own discretion. Directors need to fully understand fair use in order to apply it properly.

The attitudes of the directors were apparent from the comments made on the questionnaire and from the follow-up interviews. Over half of the population returned the instrument in some form. Given the time and effort required to complete the questionnaire, copyright must be an important issue for media directors to invest that much effort. This became further apparent when many respondents attempted to justify their shortcomings at the end of the survey. Many expressed the importance of the issue and knew they that needed to be well informed.

Each of the directors who were interviewed had received or participated in some type of copyright training. Many spoke of workshops, reference materials, or conference activities as the source for the insight they had gained on the subject. None of the interviewees were apathetic or ambivalent to the issues of copyright in education. In fact, the reverse was true. Most of the directors had a specfic point of view that they felt was important to convey. Often this position was expressed as soon as they were asked the first question. Often this position was a recurring theme in the answers to many of their questions (i.e. new technologies are making copyright more difficult, educating our faculty is the most difficult aspect, our institution does not see this as an important issue, overly conservative interpretations of fair use will eventually hurt us all).

As might be expected there were no clear solutions provided by the interviews. The concensus agreed that we needed to keep working to assure educators are provided representation in the modeling of new guidelines and in the creation of future copyright acts. While the results of the mailed survey showed a minor percentage of directors at the competency level, the interviews and the comments indicated that directors are aware of the issues and what is at stake. Copyright is a difficult issue to manage on college campuses. The struggle to maintain ethical practices and work within institutional budgets sometimes causes a strain on middle managers, like media directors. They are caught between the faculty's request for services that may border on infringement, and a budget that cannot provide a purchase request for needed materials to provide instruction. A clear policy instituted by a knowledgable director is the best way to provide equity to all the parties involved.

Conclusions

The results of this study demonstrate that the majority of media directors across the country do not have a proficient knowledge of the copyright law and related guidelines. A meager 18% were able to achieve the established proficiency level of 75%. All of the questions that they were asked came directly from the law and related guidelines. The study intentionally eliminated any questions that might have an ambiguous answer or would cause debate over interpretation.

The positive result from these findings is that the percentages appear to be moving upward. The 18% of proficient respondents is the highest level achieved in any of the previous studies. The follow-up interviews also demonstrated that there is an acute awareness of copyright in the media profession in higher education. Media directors may not always have the correct answer to copyright questions, but they will usually have an opinion. Almost all of the directors mentioned some type of professional development that they had done concerning copyright. Some of the work had been voluntary, but others described mandatory sessions that they attended at a local or state level.

This study focused on members of AECT, the largest professional organization for media professionals. The organization maintains a copyright committee that works to educate and inform the group members. It should be noted that the results of this study showed the positive influence that the group is beginning to have. Many of the members referred to the column the committee sponsors in the association's publication, Tech Trends. When asked about the efforts of AECT in providing copyright information, 90% of the directors responded with a "very good" or "excellent". They were familiar with the workshops the group had conducted and the sessions they had sponsored. The lone negative response was from a member who was upset over the association's lack of support for an initiative that another organization was sponsoring. Further investigation into the situations revealed that AECT had provided considerable support and representation to the initiative.

The work of AECT needs to continue and be expanded. They have at hand a critical issue that is at a highly vulnerable stage of development. The issues in copyright are remerging in the continued development of technology. As this work goes to press, the presidential commission on the National Information Infrastructure (NII) Advisory Council is preparing a document to begin to deal with many of the issues brought on by the information highway. One of those issues will be copyright. The report from that council will be the blueprint for the structure of future copyright legislation and guideline development. AECT can take the leadership role by recognizing these developments and championing the causes of its constituents.

Recommendations for Improvement & Future Study

The educating of media directors needs to continue. The study results show that there are some obvious knowledge gaps in media directors' backgrounds. In particular, the interpretation of fair use is still a misunderstood, and misapplied concept, and should receive the greatest concentration. The content areas concerning the music and off-air guidelines also need more consideration or instructional emphasis. However, the scores show that there actually is no area of the law in which the media directors can demonstrate a competency.

The dissemination of information needs to continue from professional organizations government bodies, and other concerned parties. AECT's efforts were mentioned favorable by almost all of the interviewees. AECT's publication *Tech Trends* features a regular column on copyright. Their efforts should be continued and expanded. The AECT copyright committee is currently considering sponsoring a teleconference. Two copyright teleconferences have been aired recently, but both were targeted at different audiences. Such a venture would reach many professionals. New avenues, like teleconferences, need to be continually developed in attempting to reach practioners with information.

New questions are continually being asked as technology changes and the answers to old questions are constantly being reevaluated. The debate and disscussion of these issues is important if we are to come to any resolutions. This should take place through a variety of methods including most of those currently being used like professional journals, conference sessions, and workshops. One of the newest forums is the Internet listserv "cni-copyright", a moderated discussion list on copyright and intellectual property rights issues. Educational issues are occasionally discussed on this list. It would be desirable, as some of the intervewees suggested, to have a listserv dedicated to educational copyright issues with a content expert to moderate the discussion. Perhaps one of the professional organizations could sponsor and moderate such a list.

Additional study is needed to collaborate the findings of this and previous studies. Different data collection methods will help validate the results of this study, as well as, provide additional insight. One suggestion would be to query members in person, perhaps at a national convention. By asking a group of them the same question at the same time, the results may provide unique findings.

Different populations could be examined. The relationship between the MLA degree professionals and non-MLA professionals provided little data. By using a similar instrument with American Library Association non-print media librarians and contrasting the results from this study, a significant relationship may be apparent. Another study might look at the relationship of the faculty's knowledge level versus the media director's knowledge level. Does a well informed director with a clear copyright policy translate into a faculty that has a basic understanding of the law?

The revision of the instrument needs to continue for any further study. The questions should continue to be revised. As more guidelines become available for distance learning, multimedia, and computer software, they should be included in the instrument. It should also be possible for the respondents to indicate "not applicable" as a response. If an area of the law is not relevant to their work, it should not be included in the analysis of their performance. The response of "don't know" might also be added to the list of choices on the instrument. This would help clearly identify areas of the law with which the population is unfamiliar.

Summary

The educating of media directors across the country needs to continue. If media directors are to take full advantage of the educational exemptions without infringing on exclusive rights, they must have a thorough understanding of the law. Many educators are frustrated by the limitations of the Copyright Act, but if they fully understood the law and its intent, they would understand the liberal degree of latitude that is available. While most directors have some knowledge of the law, only 18% can demonstrate a criterion level of competency. The area of fair use is one specific aspect that requires additional work. Professional associations like AECT and CCUMC need to continue their work and disseminate information about copyright. Directors need to also take the initiative to own and refer to copyright reference materials. The ethics of the media profession are continually being molded by the behaviors of media directors across the country.

A proficient knowledge of the copyright law should be a priority for every media professional.

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Title:

An Instructional Theory for Learner Control: Revisited

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I. Research Background

Learners should be able to feel free to optimize their potential and to hold their own in any setting. *Becoming empowered* means learning how to influence and interact with the challenges of one's life in such a way as to maximize performance. We live in an age of empowerment. The term *empowerment* has come into use in public education and the business worlds. Just as the individual school is viewed by most people as the basic primary source of change and improvement, so too is the training and development center in the corporate environment.

Educators concerned about the empowerment of learners have seen that a restructuring of schools may be necessary if empowerment of learners is to be realized. So it is that the notion of "school restructuring" has been discussed in the same context as empowerment(Banathy, 1987, 1991; Bateman, 1990; Elmore, 1989; Harvey & Crandall, 1988; Murphy, 1991). In other words, learners should be at the heart of educational processes. Meanwhile, educators should facilitate and empower learners to take control of their own learning(Chung, 1991).

Empowerment would necessarily involve a consideration of learner control or self-instructional management. Learner control has been one of the most important issues in the field of instructional technology and especially it is the major instructional management strategy (Heinich, 1973; Hoban, 1965; Reigeluth,1989). Each learner's control of instruction is inherently appealing to learners, since it is assumed that learners will be more motivated if they are allowed some control over their own learning.

Research findings regarding the effects of learner control have been *inconclusive* (Carrier, Davidson, & Kalweit, 1986; Ross & Morrison, 1989; Steinberg, 1977; Tennyson, 1980). Whatever the causes for the inconclusiveness of the research into the effects, it is time for us to count on the prescriptive knowledge base of learner control as a means to empower learners. Educators must require more systematic guidelines for implementing effective learner control in their instructional situations in order to maximize the learners' performance.

The purpose of this study is to develop a prescriptive theory of learner control for educators to support the learner's decision making in the learning process and to manage more efficiently their instructional process. The theoretical framework of learner control in conjunction with the self-regulation of learning, learner characteristics, and learner motivation may make educators and instructional designers understand why it may be effective to allow learners to have some control over the learning process. In this study, the author assume that development of an instructional theory for learner control would answer some needs of our information society. This theory would facilitate educators' new roles by providing practical guidelines for more effective instructional management. Thus, educators can help their students to take control of their own learning process with confidence and responsibility. In a nutshell, the author expects this prescriptive theory to be a meaningful mechanism to empower learners in our society.

II. Research Questions

The major questions of this study were:

(1) What are the important factors required to empower learners in managing their learning? What is the functional relationship among those factors?

(2) What types of learner control or learners' decision-making roles are available in learning situations? What would be the educator's role to enhance and support the learner's own learning process before, during, and after instruction?

(3) Under what conditions (condition and outcome variables) can a specific learner-control strategy be considered as an associated solution or a combination of solutions (method variable)? In other words, when is and isn't a certain learner-control strategy (or a combination of strategies) recommended? What are the associated critical success factors?

Research questions 1 and 2 will be mainly answered by review of relevant literature. Question 3 and part of question 2 will be clarified and answered through the instructional theory construction process using inductive and deductive approaches based on empirical research, theoretical research, and intuition. As a matter of fact, the work of theory construction is iterative and recycling. After all, the questions (1,2, and 3) described above can be answered altogether and interrelated in the systemic viewpoint.

III. Research Procedure

We need to know the reason why the author exploit the methodology (theory construction, especially using both deduction and induction methods) and how to progress this work.

A. Rationale

In the current study, I exploit both the inductive and the deductive approaches. The inductive method is *primarily* adopted in analyzing the empirical research, building a knowledge base of learner control and learner decision-making skills, and constructing the current *prescriptive* theory for teachers which will support learners' appropriate control decisions during the instruction and learning processes. According to Snelbecker (1985), in the inductive mode of theory construction, statements are summarized or generalizations are derived from empirical facts. Such theories work "from the bottom up," developing into higher-level systems which generalize across small theories, and eventually culminating in a theory which can account for all the statements lower in the schema. The strength of this approach is that the statements produced are *not* too far from the "truth" which has been verified. The weakness of this inductive thinking is that it can often lead to a proliferation of very low-level theories, many of which are not unique and contain considerable overlap in function(Hoover, 1984; Noble, 1976; Snelbecker, 1985; Turner, 1968).

Meanwhile, the deductive method is used intuitively both in synthesizing theoretical research and connecting a knowledge base to the development of taxonomies which form the core of a *conceptual model* for learner control. The conceptual model for learner control will be the beginning stage of the current theory construction. In the deductive approach, theorists work "from the top down," building a theory that seems logical on an "a priori" basis and then testing the correctness of this theory (Babbie, 1989; Noble, 1976; Snelbecker, 1985; Turner, 1968). This type of approach is good in terms of comprehensiveness, breadth, and a consistency among rules. However, the problem in deductive thinking is the lack of empirical foundation and a good deal of needless research if the majority of the original postulates prove to be incorrect. In this study, the author exploited both the inductive and the deductive approaches. Figure 1 explains how the approaches were applied.

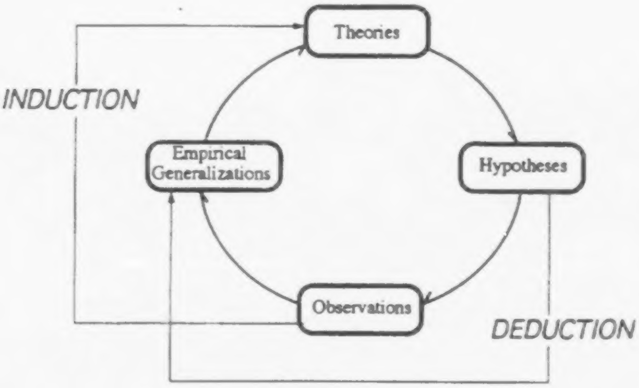

Figure 1. The Wheel of Science

B. Procedure

This procedure became the general guidelines for the author to build the theory. First of all, a literature review was conducted. Next, a conceptual model of learner control will be developed. Then, both empirical and theoretical research findings will be integrated on the basis of the conceptual model. Lastly, a prescriptive instructional theory will be constructed. However, in fact the theory development process was very reiterative and recycling in all directions.

1. Reviewing Literature

Literature is the source for a sketch of conceptual models and an instructional theory. Reviewing literature is the very first step in the current theory construction. This study reviews a variety of literature (both empirical and theoretical) relevant to decision making, human performance and motivation, learner control, and theory construction. The literature was obtained from discussion and consultation with professors and colleagues, from books, journal articles, conference papers, Psychlit, and ERIC microfiches across the areas of education, psychology, and business.

2. Developing Descriptive Conceptual Models

Through the literature review process, the conceptual models were developed. The conceptual models in this study has two shapes: one is a diagram of variables (Figure 2); the other is a diagram of the process (Figure 3). Figure 2 identifies and organizes the relevant variables affecting a learner's decision making and describes relationships among the variables. Figure 3 shows the roles (interaction or relation) of learners and teachers in a given learning environment. The models were products of the synthesis of intuition, and the related research and knowledge base about learner control. They facilitated a theory development. In other words, the conceptual models were the basis of development of formative hypotheses and the taxonomy of variables of instructional theory.

3. Integrating Research Findings

When a quantity of relevant research data is gathered and analyzed, the research findings were integrated on the basis of the conceptual models so that logical conclusions can be drawn. As result of this activity, a set of principles were produced. Each principle consists of condition(s) and method(s). The credibility of a theory is dependent upon the component constructs, as well as the substance of the principles of the theory.

4. Constructing the Prescriptive Instructional Theory

Inductively integrated knowledge which is based on research findings concerning learner control was changed into a prescriptive form in order to provide teachers and instructional designers with a guide to empowering learners. After identification of four major sets of conditions, the current study produced the theory by prescribing four instructional models of learner control to cope with individual learning and instructional situations. The deductive approach was also used to improve the framework of the theory.

On the basis of Conceptual Model 1(Figure 2) with integrated research findings, critical condition variables (such as learner ability, prior knowledge, types of learning, task importance), critical method variables(such as content control, sequence control, pace control, and display control), and critical outcome variables (or dependent variables such as achievement and attitude) were identified. The interrelationships between the critical variables were identified. At this point, prescriptive principles were matched with situations.

Based on method variables, four instructional models (A, B, C, D) were constructed to match the four conditions. First, I decided that each model should consist of three instructional tactics: (1) providing learners with an *introduction*, delivered by an instructor or a program, about how to use learner control effectively in the given program, (2) allowing learners to use some degree and type of control *options*, and (3) providing *instructional (or control) advice* during the program. Then, the second kind of instructional tactics (allowing learners to use instructional options available in the progress of learning) were mainly inductively identified from Conceptual Model 1. However, the first and the third tactics were identified primarily deductively on the basis of Conceptual Model 2. As a result of induction, deduction, and integration of conceptual models, Figure 4 (the overall picture of the theory) was created. All the key principles under the critical success factors (CSF) in each model were listed.

IV. Results

The results of this study are composed of two descriptive conceptual models and a prescriptive instructional theory for learner control in which includes four instructional models .

A. Descriptive Conceptual Models

1. Conceptual Model 1(Variable Relationship)

There are three groups of variables: condition, method, and outcome variables. Condition variables include learner variables (such as age, ability, prior knowledge, cognitive style, and motivational level), content variables (such as learning type and task importance), and environment variables (such as climate and medium). Method variables (i.e. learner control strategies in present study) include content control, sequence control, pace control (time management), and display control. Each method variables will be defined later in the prescriptive instructional theory learner control. Outcome variables include learner performance (or achievement), learner attitude, continuing motivation to learn, number of selection, anxiety, and learning time.

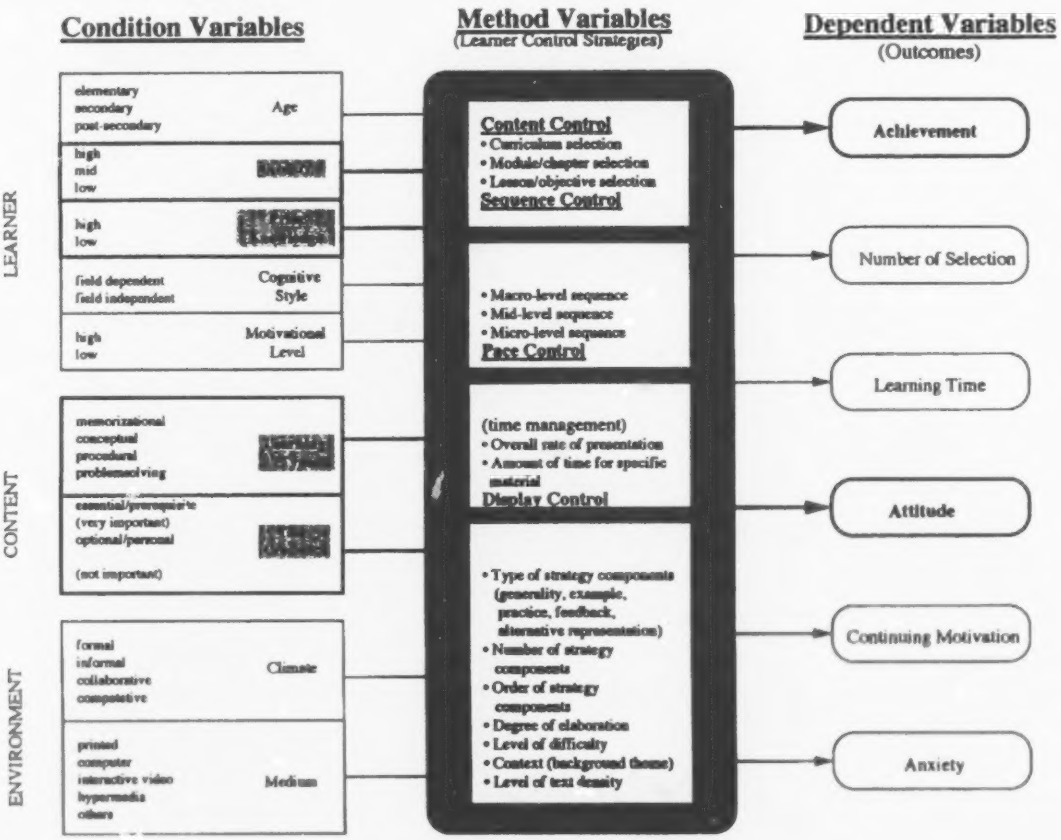
Condition Variables
Method Variables
(Learner Control Strategies)
Dependent Variables
(Outcomes)
LEARNER
elementary
secondary
post-secondary
Age
high
mid
low
high
low
field dependent
field independent
Cognitive Style
high
low
Motivational Level
CONTENT
memorizational
conceptual
procedural
problemsolving
essential/prerequisite
(very important)
optional/personal
(not important)
ENVIRONMENT
formal
informal
collaborative
competetive
Climate
printed
computer
interactive video
hypermedia
others
Medium
Content Control
• Curriculum selection
• Module/chapter selection
• Lesson/objective selection
Sequence Control
• Macro-level sequence
• Mid-level sequence
• Micro-level sequence
Pace Control
(time management)
• Overall rate of presentation
• Amount of time for specific material
Display Control
• Type of strategy components (generality, example, practice, feedback, alternative representation)
• Number of strategy components
• Order of strategy components
• Degree of elaboration
• Level of difficulty
• Context (background theme)
• Level of text density
Achievement
Number of Selection
Learning Time
Attitude
Continuing Motivation
Anxiety

Figure 2. Conceptual Model 1 (Variable Relationships)

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As a result of the integration of empirical and theoretical findings on the conceptual model 1, the author could identify the relationships among the variables as Figure 2. These relationships are the basis of the prescriptive instructional theory of learner control. Figure 2 indicates, on the basis of the number of variable relationship involved, that achievement and attitude to a large extent, and anxiety and learning to a less extent, are decisive dependent variables. Especially, the degree of learner experience (ability and prior knowledge), the degree of task importance, and types of learning are the critical factors of condition variables in the present theory.

2. Conceptual Model 2(Self-Managed Learning Process)

Figure 3 describes the self-managed learning process. A learner (1.0) becomes an *empowered* learner (3.0) through the learning process (2.0). The learning process consists of a session of training about decision making (learning strategies), self-managed learning experience, and self-assessment by the learner. In conceptual model 2 (Figure 3), we can identify the roles of a learner and an educator. The learner will be the center of the learning process and he/she will be an active participant in the whole learning process with self-regulation skills. The educator can provide knowledge and skills in the pre-training session. The educator can also advise, counsel, facilitate, and influence learners during the learners' self-managed learning experiences. The educator can provide learners with informative feedback during or after learning session. During this process, a learner's schemata (cognitive structure) changes one time, either by a process of accretion, or a process of tuning, or a process of restructuring. Often a meta-process is involved which consists of a mixture of all three processes, with the mixture varying one time.

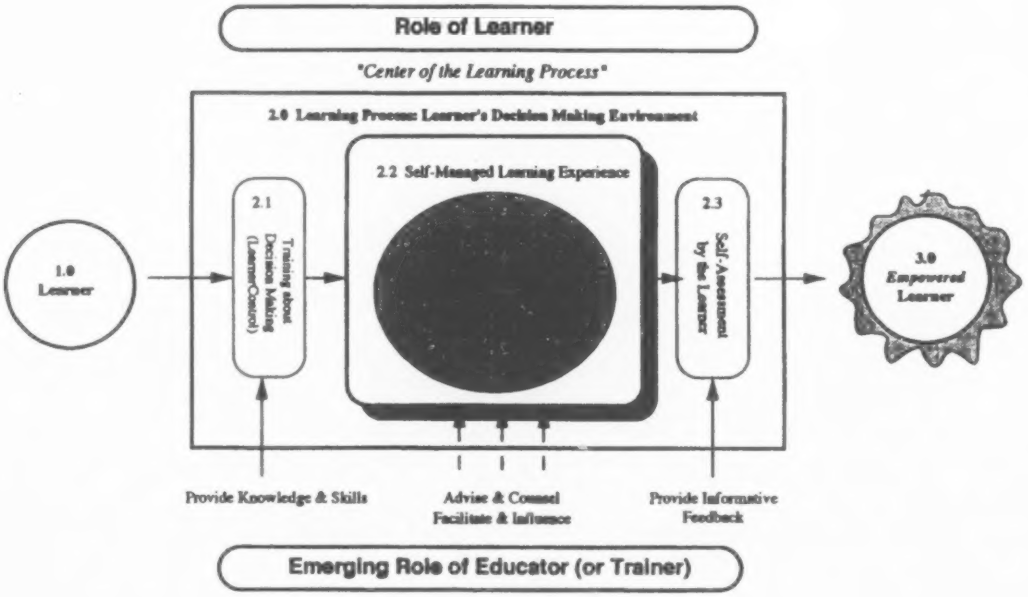
Role of Learner
"Center of the Learning Process"
2.0 Learning Process: Learner's Decision Making Environment
2.2 Self-Managed Learning Experience
2.1
Training about Decision Making (LearnerControl)
2.3
Self-Assessment by the Learner
1.0 Learner
3.0 Empowered Learner
Provide Knowledge & Skills
Advise & Counsel Facilitate & Influence
Provide Informative Feedback
Emerging Role of Educator (or Trainer)

Figure 3. Conceptual Model 2. (Self-Managed Learning)

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B. A Prescriptive Instructional Theory

This theory prescribes what models based on different conditions are likely to optimize the desired instructional outcomes. Four distinct models operationalize this instructional theory for learner control. As in Figure 4, Model A is most learner-control oriented and Model D is least learner-control oriented (a continuum).

1. Taxonomy of Variables for the Instructional Theory

Instructional Goal (Outcome): For all four models in this theory, the desired learning outcome (that is, instructional goal) is to meet different individual learner needs. Instruction is judged by its effectiveness, efficiency, and appeal in the context of instructional management (Davies, 1984; Reigeluth & Merrill, 1979).

Instructional Conditions: The selection of instructional methods in this theory is mostly determined by two sets of condition variables: 1) learner experience and 2) task importance (Korotkin, 1992; Davies, 1993; Grau, 1986; McMillan & Spratt, 1983; Weiner & Brown, 1984).

Condition 1:	If the learner has a high experience and if the task is less crucial;
Condition 2:	If the learner has a low experience and if the task is less crucial;
Condition 3:	If the learner has a high experience and if the task is more crucial;
Condition 4:	If the learner has a low experience and if the task is more crucial.

Instructional Methods: In this section, instructional methods are divided into the types of learner control exploited in the field, the role of educators, and the degree of learner control.

a) Types of Learner Control: Roles of active learners
These learning activities can be arranged into four broad classes of control: learner control of content, learner control of sequence, learner control of pace, and learner control of instructional display (strategy).
- *Learner control of content.*(Merrill, 1983).
- *Learner control of sequence.*(Merrill, 1979; Milheim & Martin, 1991; Reigeluth & Curtis, 1987).
- *Learner control of pace (time management).*(Milheim & Martin, 1991).
- *Learner control of instructional display (strategy).*(Merrill, 1984; Ross, Morrison, & O'Dell, 1989; Ross & Morrison, 1989).

b) Role of Educators
- *Developing metacognition and cognitive strategies of learners.* (Merrill, 1984; Flavell, 1976; Resnick, 1972; Corno & Mandinach, 1983; Gagné & Glaser, 1987).
- *Instructional advisement.* (Milheim & Azbell, 1988; Tennyson & Rothen, 1979).

c) Degree of Control: The degree of control is a continuum from maximum program control (that is, minimum learner control) to maximum learner control.

2. Four Instructional Models of Learner Control.

Four prescriptive instructional models (Model A, B, C, and D) will be elaborated here. Each will be described in terms of the tactics involved and each will identify a precept or rule as a critical success factor (CSF) to the model.

Model A

If the learner has a high experience (ability and prior knowledge) and the given task is not crucial ("Condition 1") in the learning, then the optimal prescription for instructors or instructional designers in this instructional theory for learner control is Model A.

(Goal: To meet individual learner needs)

		Models
Conditions	[illegible]	**Model A** * [illegible] • Time [illegible] • Display (Strategy): [illegible] [illegible]
	If a learner has a low experience and if a given task is less crucial	**Model B** * Introduction * Control • Content Selection: Learner control • Sequence (Path): Learner control • Time Management: Learner control • Display (Strategy): Program control * Instructional Advice
	If a learner has a high experience and if a given task is more crucial	**Model C** * Introduction * Control • Content Selection: Program control • Sequence (Path): Program control • Time Management: Learner control • Display (Strategy): Learner control * Instructional Advice
	If a learner has a low experience and if a given task is more crucial	**Model D** * Introduction * Control • Content Selection: Maximum program control • Sequence (Path): Maximum program control • Time Management: Learner control • Display (Strategy): Program control * Instructional Advice

Figure 4
Models of Instructional Theory for Learner Control

The three instructional tactics in this model are: a) providing the introduction or training on learner control; b) allowing learners to use instructional options available in the progress of learning; and c) providing instructional advisement for effective learning. Usually c) is embedded in b). In condition 1, tactic a) is less important than in other conditions.

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a) Critical success factors for learning strategies training:

CSF: *Provide learners with directions in how to use learner control strategies in order to promote a learner's performance.*

CSF: *Provide learners with directions for conscious cognitive processing of the information in order to improve their performance* (Callahan & Merrill, 1978; Merrill, 1984; Reigeluth,1979; Strickland, Fletcher, & Merrill, 1978; Wilcox, Richards, Hindmarsh, & Merrill, 1978).

b) Critical success factors for experiencing control options:

CSF: *A high degree of learner control over content selection (what to learn) is advisable when it is beneficial for learners to set their own learning goals*(Ross & Rakow, 1981; Steinberg, 1991).

CSF: *High degree of learner control over sequence of content is advisable.*(Leshin, Pollock, & Reigeluth, 1992; Reigeluth, 1979)

CSF: *A high degree of learner control over instructional pacing should be allowed.*(Keller & Kopp, 1987; Leshin, Pollock, & Reigeluth, 1992; Milheim & Martin, 1991).

CSF: *A high degree of learner control over strategy should be allowed*(Beard, Lorton, Searle, & Atkinson, 1973; Leshin, Pollock, & Reigeluth, 1992; Milheim & Martin, 1991). Merrill, 1983; Merrill, 1984; Reigeluth & Merrill, 1977; Reigeluth & Schwarts, 1989; Slough, Ellis, & Lahey, 1972).

c) Critical success factor for instructional advisement

CSF: *Provide learners with instructional advisement only when necessary in order to facilitate and improve learner's decision making and performance* (Hannafin,1984; Kinzie, 1990; Laurillard,1984; Merrill, Li, & Jones, 1990; Tennyson & Park, 1987).

Model B

If the learner is less experienced and the given task is less crucial ("Condition 2") in the learning, then the optimal prescription for instructors or instructional designers in this instructional theory for learner control is Model B. Like Model A, there are also three instructional tactics in this model:

a) Critical success factors for learning strategies training:

CSF: *Absolutly provide learners with directions in how to use learner control strategies in order to promote a learner's performance.*

CSF: *Absolutely provide learners with directions for conscious cognitive processing of the information n order to improve their performance.*

b) Critical success factors for experiencing control options:

CSF: *Learner control over content selection (what to learn) is advisable.*

CSF: *Learner control over sequence of content is advisable.*

CSF: *High degree of learner control over instructional pacing should be allowed.*

CSF: *Learner control over strategy should be restricted.*

c) Critical success factor for instructional advisement

CSF: *Provide learners with instructional advisement only when necessary in order to facilitate and improve learner's decision making and performance.*

Model C

If the learner has a high experience and the given task is more crucial ("Condition 3") in the learning, then the optimal prescription for instructors or instructional designers in this instructional theory for learner control is Model C. There are also three instructional tactics in this model:

a) Critical success factors for learning strategies training:

CSF: *Absolutely provide learners with directions in how to use learnercontrol strategies in order to promote a learner's performance.*

CSF: *Absolutely provide learners with directions for conscious cognitive processing of the information in order to improve their performance.*

b) Critical success factors for experiencing control options:
CSF: *Learner control over content selection (what to learn) is restricted.*
CSF: *Learner control over sequence of content is restricted.*
CSF: *High degree of learner control over instructional pacing should be allowed.*
CSF: *High degree of earner control over strategy should be allowed.*

c) Critical success factor for instructional advisement
CSF: *Provide learners with instructional advisement only when necessary in order to facilitate and improve learner's decision making and performance.*

Model D

If the learner has a low experience and the given task is very crucial ("Condition 4") in the learning, then the optimal prescription for instructors or instructional designers in this instructional theory for learner control is Model D. There are three instructional tactics in this model:

a) Critical success factors for learning strategies training:
CSF: *Provide learners with directions in how to use learner control strategies if necessary.*
CSF: *Provide learners with directions for conscious cognitive processing of the information if necessary.*

b) Critical success factors for experiencing control options:
CSF: *Learner control over content selection is restricted.*
CSF: *Learner control over sequence of content is restricted.*
CSF: *High degree of learner control over instructional pacing should be allowed.*
CSF: *Learner control over strategy should be restricted.*

c) Critical success factor for instructional advisement
CSF: *Provide learners with instructional advisement only when necessary in order to facilitate and improve learner's decision making and performance.*

Figure 5 is a summary table of learner control strategies of each model. All learner control strategies are allowed in Model A. Meanwhile, most learner control strategies are restricted in Model D.

← more LC oriented   less LC oriented →

Models / Strategies		Model A	Model B	Model C	Model D
Introduction (Pre-training)		less important for some	important	important	important
Control Options	Content Control	maximum learner control	learner control	restricted LC (PC)	minimum LC (max.PC)
	Sequence Control	maximum learner control	learner control	restricted LC (PC)	minimum LC (max.PC)
	Pace Control	learner control	learner control	learner control	learner control
	Display Control	learner control	restricted LC (PC)	learner control	restricted LC (PC)
Instructional Advice		important	important	important	important

- LC: learner control
- PC: program control

Figure 5. Summary Table of Learner Control Strategies of Each Model

V. Conclusions and Educational Implications

The results of this study permit several conclusions about the instructional theory construction for learner control. The following conclusions seem noteworthy.

1. There are three major variables affecting learning process and learning control decisions. Those are condition variables, method variables, and outcome variables.

2. The most important critical variables which influence the learner control decision (method variables) are (a) the experience of a learner and (b) the importance of task. The combination of these two variables creates four instructional conditions of my learner control theory.

3. A learner's role in the self-management learning environment is to be an active participator with self-regulation skills (metacognition).

4. The role of an educator or instructional agent in the self-management learning environment is to be a facilitator and mediator of learning with instructional and organizational roles.

5. There are four instructional conditions of learner control theory and four instructional models for matching each instructional situation. Each instructional model has three instructional tactics:
   (a) Developing self-regulation skills of a learner.
   (b) Allowing a learner to use the degree and the type of control.
   (c) Providing instructional advice during learning.

6. There are several CSFs which are critical to the success of the instructional theory prescriptions for learner control.

This theory expands previous conceptualizations of the roles of learners and teachers by exploring the decision-making process and the interrelationships of learner factors, content factors, environment factors, and delivery factors. This theory links previous research findings and practitioners' prescriptions within a logically consistent framework. Theoretical research, because it deals with abstraction and relationships, is often more demanding than other forms of inquiry. However, theory construction is essential to support or question the foundations of practice.

This study takes a first documented step toward theory construction for empowering learners to manage the learning process. It is a exploratory attempt to improve the common practice of education and training. The recommendations resulting from this study fall into two main categories: one is for evaluation of the theory developed in this study; the other is for expansion of the theory.

For evaluation of the theory:

1. In the future, this theory must be examined within the limits of experimental research design. The investigation results can serve as further tests of the components of the theory.

2. The theory can also be evaluated by a large sample of experts and practitioners (teachers and trainers). It is expected that further research and testing efforts will lead to refinements. The use of experts' opinions for assessing the worth of a product is probably the oldest evaluation strategy used in education. Experts' and practitioners' opinions can be an important evaluation tool because it is quick and enhance the credibility of the theory.

   The instructional prescriptions developed in this study were validated with empirical and theoretical research by the author. But the instructional theory need also to be validated in terms of optimality and utility by both experts in the field of instructional theory and learner-control research and practitioners in the education and training..

For expansion of the theory:

1. Additional work can be done to find the relationship between motivational design and learner performance in the self-managed learning environment. The motivational effects is expected to make the instructional theory for learner control more dynamic.

2. Additional work should be done to develop more flexible instructional theory for learner control in order to cope with advanced information technologies including intelligent tutorial systems, expert systems, and computer-based simulations and games.

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Title:

Learning from Learning from Instruction: Reconceptualizing the Research Environment

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OBJECTIVE

The task of synthesizing descriptive data from the "root social sciences" (Clark, 1989) to form a usable model for applied research is quite different than the task of employing, verbatim, the theoretical and methodological constructs of those same sciences. Certainly learner competence is a goal or end product that applied fields concerned with instructional theory hold in common with the root social sciences concerned with learning/cognitive theory, but the means of arriving at the end product is, or should be, different. Therefore, the objective was to conceptualize (in the phonemic tradition) the instructional encoding conditions that potentially effect and/or affect the encounters of predisposed learners/decoders involved in perceiving, differentiating, recalling, manipulating, and/or using knowledge.

THEORETICAL FRAMEWORK

Perhaps the most pervasive problem with research on learning from instruction has been the lack of inclusiveness: our inattention to the totality of the instructional environment. Separately, we have covered several variables, usually more than one at a time, including learner, teacher, and treatment characteristics, environmental or situational conditions, intrinsic and extrinsic motivation, media characteristics, response characteristics, and factors related to the instructional message or task.

In the past, our commitment to the constructs imposed by a particular discipline has failed to produce the consistency, generality, and commonality needed for the development of a comprehensive model for applied research on learning from instruction. In the future, the relations between learning/cognitive theory research and learning from instruction research must be reciprocal: each should serve, in part, to strengthen the other.

Without some acknowledgment of the effective and affective processes involved in learning from instruction, applied research efforts will continue to produce extremely limited observations. Learning from instruction should be based, in part, upon the constructs of learning/cognitive theory, but instructional theory should not be confused with learning/cognitive theory.

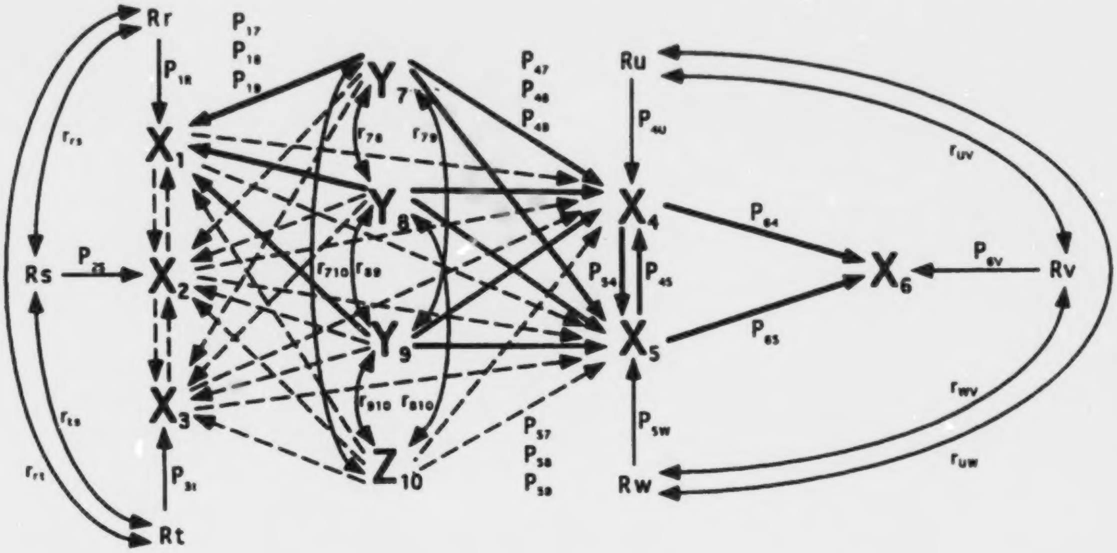
TECHNIQUE

The path model (Figure 1) depicting the ontological dependence and functional relations (see Fenstermacher, 1986 and Travers, 1981 for a discussion of, and rationale for, these terms) of the variables of instruction was patterned after the LISREL 7 model by Jöreskog & Sörbom (1989). Inferencing strategies were employed to identify qualitative and theoretical surface features that may or may not be considered during the encoding phase of instruction, but that are certainly potential indicators of interactions during the decoding phase of instruction. The model is nonrecursive, with both temporal and conceptual sequences employed to estimate pathways of influence. The model is based upon the presumption that there is both theoretical and intuitive commonality among researchers and practitioners interested in learning from instruction. For such a model to be of value to all researchers within an applied field of study, it must be eclectic. It must be broad enough to include our quantitative and qualitative research interests, and dynamic (nonlinear) enough to allow for the inclusion of various theories pertaining to what, where, when, how, which, and why learners learn. The model was used as a heuristic technique (not as an analytical device) to conceptualize, albeit naive, *a priori* encoding conditions.

NOTATION AND DEFINITIONS

Several types of variables are illustrated in Figure 1. The X_i's represent endogenous variables which are effected/affected by other variables from within the model. The Y_i's (innate qualities) and the Z_i (experiential qualities) are termed exogenous variables since they are not effected/affected by other variables from within the model during the time pre-instructional encoding conditions are being considered. Exogenous variables are, in fact, the inherent substance of the endogenous variables: the differentiated developmental modes innately existing within, acquired by/from experience (socioculturally constructed), or designed into the variables of instruction. The double-headed curved arrows represent unanalyzed correlations between exogenous variables. The R_i's represent residual variables (error variances) that impinge upon the other variables within the model, but for which no observations are gathered. Two kinds of intermediary relations are depicted in the model. Functional relations between the variables are represented by solid arrows; however, no causal relations, in the Newtonian sense, were intended. Similarly, ontologically dependent relations are represented by dashed arrows. The P_{ij}'s are referred to as path coefficients that represent the estimated impact of one variable upon another. (Note that only solid arrows have such designations and that for clarity some have been labeled outside the model, above and below the respective solid arrows.)

Figure 1. A Path Model of Encoding Conditions that Prefigure Learning from Instruction.



Learner Processes	X_1	Predisposed modalities of inference (intellectual, physical, emotional, sociocultural) that facilitate or suppress learning (achievement, process) from instruction.
Task Requirements	X_2	Prior and/or new implicit and/or explicit characteristics of knowledge structures and/or processing demands.
Resource Attributes	X_3	Qualitative and/or theoretical surface features employed to present and/or represent and convey temporal, spatial, or spatiotemporal characteristics.
Teacher Considerations	X_4	Predisposed conceptions of prior and/or new implicit and/or explicit structural and/or processing demands of the task and of the predisposed learner.
Teacher Considerations	X_5	Predisposed perceptions of qualitative and/or theoretical surface features essential for economical representation of the task for the predisposed learner.
Teacher Considerations	X_6	Predisposed formulations of concomitant encoding conditions predicated to be indispensable for engaging the predisposed learner with the task.

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Intellectual Modalities	Y_7	Differentiated developmental modes innately existing within, acquired by/from experience (socioculturally constructed), or designed into the variables of instruction.
Physical Modalities	Y_8	Differentiated developmental modes innately existing within, acquired by/from experience (socioculturally constructed), or designed into the variables of instruction.
Emotional Modalities	Y_9	Differentiated developmental modes innately existing within, acquired by/from experience (socioculturally constructed), or designed into the variables of instruction.
Sociocultural Modalities	Z_{10}	Differentiated developmental modes acquired by/from experience (socioculturally constructed) or designed into the variables of instruction.

POINT OF VIEW

The encoding conditions that prefigure learning from instruction consist of an instructional environment that is composed of four variables: the teacher, the learner, the task, and the resources. It follows, then, that if learning (achievement, process) is the ultimate product of the instructional environment, then an effective (natural science) and affective (social science) instructional environment is the product of the interactions from within, between, and among the teacher, the learner, the task, and the resources (Clark, 1990). Intellectual, physical, emotional, and sociocultural modalities have been identified to further describe the distinctiveness of the differentiated developmental modes innately existing within, acquired by/from experience (socioculturally constructed), or designed into the variables of instruction. The model not only depicts the intermediary relations between the independent variables and the dependent variable of interest (the predisposed teacher's formulation of encoding conditions predicated to be indispensable for engaging the predisposed learner with the task), but also makes explicit the kinds of intermediary relations (functional, ontological) that exist between the variables.

It is noteworthy to observe that the functional relations (solid arrows) specified in the model represent potential interactions of inartificial innate qualities originating in, or derived from, the constitutions of the teacher and of the learner. All other intermediary relations appearing in the model represent ontologically dependent interactions (dashed arrows) of socioculturally constructed experiences. Each intermediary relation implicitly represents an hypothesis.

The functional relations, those solid arrows with path coefficients assigned, could be tested by estimating the magnitude of the relation. Since certain assumptions may not be met and/or quantitative data may not be available, equation systems for estimating the magnitude of the ontologically dependent interactions, those dashed arrows without path coefficients assigned, are unidentified at this time. Nevertheless, while quantitative estimates of the impact of one variable upon another may not be possible in every situation, this heuristic technique makes the implicit explicit by facilitating clearer thinking, which may result in the generation of additional insights regarding research on learning from instruction. The relations between and among the variables of instruction are never indifferent in their effect and/or affect upon learning from instruction. Therefore, they are of great import to our efforts in diagnosing and prescribing the between and among relations of the variables of instruction.

The implication of such within, between, and among dependence of the variables of instruction is that functional and ontological relations within the instructional environment result from the abilities of the teacher and learner to integrate the other variables in a schema that will result in a theoretically predictable performance. The yet-to-be-researched interactions that exist within the path model of encoding conditions may impinge upon current assumptions held by confirmationists regarding uncontrolled pre-existing differences within, between, and among the variables of instruction.

SCIENTIFIC IMPORTANCE

Research proceeding from this conceptual level requires not only the interpretation of the variables of instruction (teacher, learner, task, resources) and the modalities of inference (intellectual, physical, emotional, sociocultural), but of the intermediary relations (functional, ontological) as well. Together, the variables of instruction, modalities of inference, and intermediary relations can serve as common denominators for a variety of research interests in applied fields of study. Moreover, theoretical integrity would be established and/or advanced if these components were either implicit or explicit features of most, if not all, research models. To view the study of learning simply as a natural science, to be measured by statistics, is simplistic, misleading, and false; learning is a state of mind, a matter of horizons.

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Title:

The Effect of Training in Instructional Designer Competencies on Teachers' Planning Routine and their Students' Academic Achievement

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ABSTRACT

An entire class of (37) of in-service government schools teachers at Nablus district was taken to investigate the effect of 18 hours of training in Instructional Designer's Competencies (IDC) on teachers' planning routine, and their students' academic achievement.

A questionnaire measures (IDC) in five domains: analysis, design, implementation, management and evaluation, administered to the teachers twice: once before the training, and once after. At the same time, teachers were asked to teach two lessons of the subject-matter they teach in their schools in one week, and to test their students in the following week immediately. This process of teaching and testing was also administered twice: once before training and once after.

t-test for dependent samples showed that the overall mean of teachers' planning routine was enhanced significantly after receiving the training {$t(29),= -2,86$, $p<.007$}.

Lindquist Type I ANOVA and the "Scheffe" test showed the following results:

1- The general (F) showed a significant main effect for IDC's domains {$F(4:145)=3.15$, $p>.01$}, but the post-hoc ANOVA by using the Scheffe test did not show such significance among domains.
2- Teachers practiced significantly ($p<.05$) the annual type of planning better than the monthly and seasonally ones, but there was no differences between the annual and daily types.
3- Teachers practiced significantly ($p<.05$) the written form of planning better than practicing both forms: written and mental together, but there was no differences between the written and mental types.
4- Only the mental form of planning was enhanced significantly from before training to after.
5- There was no significant main effect between subjects, considering each of these independent variables: gender, number of years of teaching experience, number of training programs that the teachers have taken during in-service, teachers' college specialization, and the level of learning stage that the teachers teach in.
6- There was a significant main effect at (.01) level of significance for within subjects, the repeated measure, for each of the above mentioned independent variables which indicated that teachers' planning routine was enhanced significantly after training.
7- There was no significant interaction between the repeated measure and each of the above mentioned variables except for the learning stage ($p< 0.007$). This interaction indicated that the planning routine of elementary school teachers was increased after training. Whereas, the planning routine of teachers who teach all grades (1-12) was decreased, and vice versa before the training.

The "Pearson correlation coefficient" between teachers' planning routine and their students' academic achievement was (-.o9) before training, whereas, this correlation was improved significantly after training ($r = .51$, $p< .02$). t-test between the two correlations was significance {$t(18)=-8.9$, $p>.001$}.

Nevertheless the overall results indicated that training teachers on instructional designer's competencies enhanced their planning routine and their students academic achievement, using true experimental designs like a pretest-posttest control group design is recommended in future research.

Introduction and Review of literature:

Instructional designers have hypothesized that the potential for learner achievement is enhanced when teachers practice Instructional Designer Competencies (IDC) during the planning of their instruction (Branch, Darwazeh, & El-Hindi, 1991,1992). In fact, instructional designers believe that teachers' planning routine is enhanced when teachers receive a kind of training on how to design instruction systematically (Branch, Darwazeh, & El-Hindi, 1992; Branch, 1993,1994; Darwazeh, 1993; Earle, 1991; Martin, 1990; Reiser & Mory, 1991; and Wilkerson, & Scheffler, 1992) (See Figure 1).

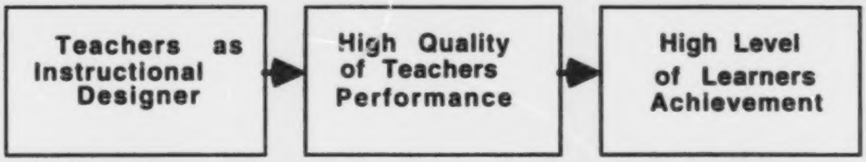
Teachers as Instructional Designer
High Quality of Teachers Performance
High Level of Learners Achievement

Figure1. Input-output relationship between designing, teaching, and students' achievement.

The systematic design of instruction, however, is defined as a discipline concerned with decision making and developing instruction through processes of selection, analysis, sequencing, implementation, management, and evaluation (Briggs & Wager, 1981, Darwazeh, 1986; Dick & Carey, 1990; Gagne, Briggs, & Wager, 1992; Merrill, 1983; Reigeluth, 1983, pp. 7-9). The role of instructional designer, accordingly, is defined as one who understands and practices the activities of the instructional design science in order to accomplish a specified purpose under a certain condition (Darwazeh, Branch, & El-Hindi, 1991; Martin, 1984, Reigeluth, 1983).

Some educators (e.g., Darwazeh, 1993; Reigeluth, 1983; pp. 7-9) have viewed the systematic design of instruction as being comprised of five major domains. They are: 1) Instructional Analysis, 2) Instructional Design or Sequence, 3) Instructional Development and Implementation, 4) Instructional Management, and 5) Instructional Evaluation. Each domain has certain activities in which all together comprised the Instructional Designer Competencies (IDC) (See Appendix 1)

Based on the concepts of Instructional Design and its activities, several models have been drawn for designing instruction (e.g., Dick & Carey, 1990; Gagne, et al. 1992; Merrill, 1983; Pratt, 1980; Reigeluth, 1983). Dick and Carey's model, in particular, has received a great deal of attention by professionals specially who work on teachers' education and care about their professional development. In some cases, this model was used as a guide for training teachers on how to plan for their teaching systematically (e.g., Applefield & Earle, 1990; Branch, Darwazeh, & El-Hindi, 1991,1992; Branch, 1993, 1994; Earle, 1985;1992). The current study is one of those cases which used Dick and Carey's model for the same purpose (See Figure 2).

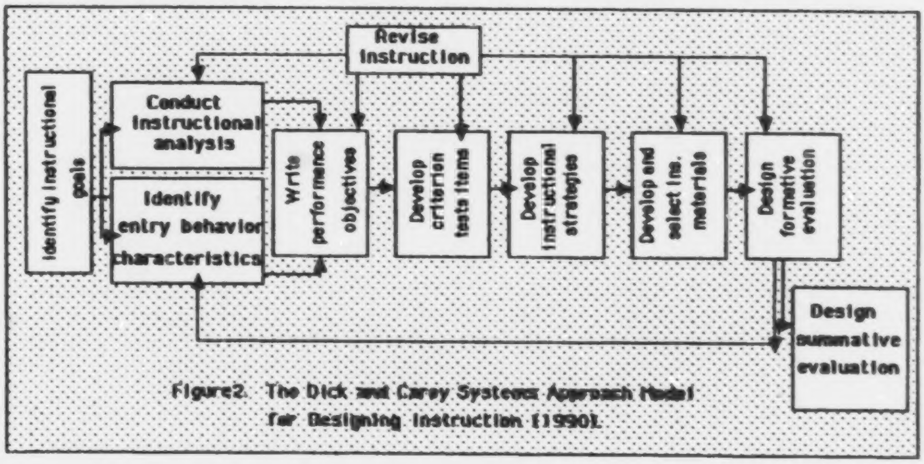
Revise instruction
Identify instructional goals
Conduct instructional analysis
Identify entry behavior characteristics
Write performance objectives
Develop criterion tests items
Develop instructional strategies
Develop and select ins. materials
Design formative evaluation
Design summative evaluation

Figure2. The Dick and Carey Systems Approach Model for Designing Instruction (1990).

The assumption behind using Instructional design models for training teachers to plan their teaching systematically is that: teachers, in fact, do engage in many instructional design practices when they plan for teaching. Clearly the roles of classroom teachers are like that of instructional designers. And taking on the role of instructional designer, on the part of classroom teachers would have a great influence on the quality of the teachers' professional performance, hence, on the level of their students' academic achievement.

To verify this assumption, educators have raised two questions:

1- To what extent do teachers practice Instructional Designer Competencies while they plan their teaching?

2- Is there a relationship between teachers who practice instructional designer competencies and their students' academic achievement?

The first question was addressed by a small number of studies. These studies tried to compare between teachers who had a knowledge or a kind of training in instructional design skills, and teachers who did not have such knowledge or skills. Martin, for example, (Martin, 1990) compared between two groups of teachers: One group consisted of five teachers who have a formal educational background in instructional systems design (ISD), and the other group consisted of five teachers who did not have such knowledge. An open and closed item questionnaire was sent to each subject and follow-up interviews were conducted. Teachers were asked about their general planning practices, written planning procedures, mental planning, and how they implement instruction based on their plans.

Results indicated that nine of the ten teachers use general ISD skills in planning. Teachers reported that they: analyze learners' need and abilities, and use objectives to guide the instructional process, specially for selecting learning activities and evaluations. Martin also found that the teachers with ISD were more specific in their responses about the use of instructional design for some aspects of planning, such as, using hierarchies and taxonomies to sequence instruction, checking the consistency among objectives, learning activities, and evaluation. In addition, she found that four of the five ISD teachers believed that knowledge of ISD has improved both their planning processes and their teaching.

Reiser and Mory (1991) have reached similar results to the above one when they conducted a study to examine the extent to which systematic planning techniques (SPT) were incorporated into the written and mental teachers planning practices. They took two experienced teachers: one had received a formal training in the use of those techniques, and the other had not. A questionnaire was administered to the teachers and they were interviewed and observed as they went about planning and implementing an instructional unit.

Results indicated that the teacher who had been trained to use (SPT) did employ them, Whereas the untrained teacher just adhered to the principle that instructional activities should be planned with objectives clearly in mind. Reiser and Mory also found that the trained teacher focused on a written plan as well as on mental one, whereas the untrained teacher focused on a mental plan only. The trained teacher also put emphasis on the consistency between the objectives and the activities she used during teaching. In addition, the trained teacher spent more time in implementing the written plan than the untrained teacher.

Branch, Darwazeh, & El-Hindi (1992) sustained the above results in some aspects. They found that the planning activities of classroom teachers correlate with the practices of instructional design professionals, and this correlation is influenced by the subject taught. Sixty-one public school teachers from the northeast United States, and a 35-item, two- part questionnaire were used for the purpose of their study.

Recently, Branch (1993,1994) tried to specify which practices teachers do more while they plan teaching, and which ones they do least. The general results of his studies were that, secondary school teachers tend to engage in some systematic instructional design practices but are selective in which instructional design practices they routinely employ. While there is a correlation between teachers' planned activities and instructional design practices, there are several instructional design practices still beyond the realm of teachers manipulation. The most important practices to all teachers were: determining course goals, breaking down curriculum goals into learning tasks, organizing the content of each lesson around central themes, and making sure the lesson fits within the entire curriculum. Whereas, the least important practices to teachers were: discussing lesson plans with others, establishing media selection criteria, soliciting input from subject matter experts, and coordinating cooperative efforts among other teacher.

By taking preservice teachers, Earle (1991, 1992) identified graduates (1980-1990) from UNCW undergraduate preservice teacher program and asked them to respond to a four- part survey which covered demographics, general information, yearly planning, unit planning, and daily planning. The results of his survey were as follows:

a) 81% of teachers felt that a knowledge of ID processes had improved their planning.

b) The crucial elements of the ID process were goals, learner analysis, objectives, tests, activities/strategies, and revision of instruction. Some other elements were considered helpful, if time allowed, such as: task analysis, classification of learning, instructional plans, and tried-out instruction.

c) Although teachers regarded mental and written planning forms as almost equal in importance at the yearly, unitary, and daily levels, they favored mental planning form overall.

d) Teachers in their planning types deviated more from yearly plans and less from unit and daily plans.

e) 52.6% of teachers do plan for their instruction formally, whereas 47.4% do plan informally.

Klein (1991) also conducted a study on preservice teachers to examine their success in acquiring and applying principles of learning and instructional design. 105 teachers enrolled in a professional teacher preparation program were taken for this purpose. They were taught the essentials of learning and competency-based instruction and were required to plan a lesson using these concepts.

Klein found that most of the preservice teachers, regardless of their specialization, were successful in acquiring and using the principles of learning and instructional design.

On the other hand, Wilkerson & Scheffler (1992) found an opposite result to Klien's. Wilkerson & Scheffler in their study tried to test the assumption that preservice teachers who are trained to develop a lesson plan, will with equal acumen, be able to implement that plan. Twenty-six preservice teachers in an early childhood practicum developed and implemented a mathematics lesson plan. The lesson plans were evaluated according to specific criteria set forth in the National Council of Teachers of Mathematics' Curriculum and Evaluation Standards for School Mathematics. The implementation of each plan was also assessed using a Likert Scale reflective of similar criteria. They found that the correlation between the scores on the lesson plan checklist, and the scores on the observation checklist was not significant.

The finding suggest that it cannot be assumed that preservice teachers will automatically make the transition from written lesson plan to classroom implementation of those plans.

Purpose of the study:

As we can see from the above results, teachers who have a previous knowledge or got some training or a course in instructional designer competencies, would plan their instruction more systematically and accurately than those who did not have such knowledge, hence the quality of their teaching performance is improved.

But the question that remains unanswered is: Do teachers who have a knowledge in instructional design, influence positively the level of their students' academic achievement?

By looking at the previous studies, none of them tried to address this issue. Therefore, the **purpose** of the current study was to address this question by investigating two kinds of relationships: 1) The relationship between instructional designer competencies and teachers' planning routine, and 2) relationship between teachers who receive a training in IDC, and their students' academic achievement.

Research Questions:

The current study tried to answer the following questions:

1- Does a training on IDC have a significant effect on in-service teachers planning routine?

2- Are teacher's practices of IDC's Domains (Analysis, Sequences, Development and Implementation, Management, and Evaluation) differ significantly from before to after training?

3- Are teacher's practices of IDC's Types (daily, monthly, seasonally, and yearly) differ significantly from before to after the training?

4- Are teacher's practices of IDC's Forms (Written, Mental, and both: mental & written forms together) differ significantly from before to after training?

5- Does the training on IDC have a significant effect on teachers' planning routine with regard to the following independent variables:

a) Gender.
b) Years of teaching experience.
c) The number of training programs that the teachers have taken during in-service.
d) Teachers' college specialization.
e) The level of learning stage that the teachers teach in.

6- What are the IDC that teachers practice (90%) or more in their planning routine?

7- What are the IDC that teachers practice (10%) or less in their planning routine?

8- Does the relationship between teachers' planning routine and their students' academic achievement differ significantly from before receiving the training to after?

Methodology

Sample:

An entire class of (37) in-service government school teachers who hold a bachelor degree in different specialization at Nablus district was taken for this study. Those teachers were enrolled in a course titled "Curriculum Design and Development" at An-Najah University as a requirement of a diploma certificate in educational training. They have different number of years of teaching experience ranging from 3 to more than 25 years of experience. They also teach grades from first through twelve.

Seven teachers were excluded from analyzing the data because they were not government school teachers rather they were either affiliated to private or UNRWA schools. Thus the final sample of this study was (30) government teachers.

Experimental Design:

One group pretest-posttest pseudo-experimental design was used for this study.

Statistical Design:

Several statistical designs were used to analyze the data in order to answer the questions of this study. They were:

1- t-test for dependent samples at (.05) a priori level of significance was used to compare between the overall mean of teachers' planning routine before and after receiving the training on IDC.

2- Lindquist Type 1 ANOVA with repeated measures on one factor was utilized separately for each of the following independent variables:

a) Instructional Designer Competencies' Domains.
b) Instructional Designer Competencies' Types.
c) Instructional Designer Competencies' Forms
d) Gender.
e) Years of teaching experience.
f) The number of training program that the teachers have taken during in-service.
g) Categories of teachers' major specialization.
h) Subject-matter groupings
I) The level of learning stage that the teachers teach in.

3- A "Scheffe" test was used whenever F-test showed significance at .05 level.

4- The "pearson r correlation" was computed twice between the overall mean of teachers planning routine, and the average mean of their students achievement test: Once before the training, and once after. t-test for dependent samples at .05 a priori level of significance was also used to compare between the two correlations.

Questionnaire:

1- Questionnaire Construction:

Based on Dick and Carey's model of the systematic approach of instruction (Dick & Carey, 1990), and Reigeluth's classification of instructional process domains, and by referring to the questionnaire of IDC which was developed by Branch & Darwazeh (Branch, Darwazeh, & El-Hindi, 1991, 1992), A 41-item Likert scale-type questionnaire of 1-5 points measured instructional designer competencies (IDC) was constructed. The questionnaire covered five domains: 1) seven items for analyzing instruction, 2) seven items for designing or sequencing instruction, 3) nine items for developing and implementing instruction, 4) five items for managing instruction, and 5) six items for Evaluating instruction.

Another seven items were added to the questionnaire: Four of them asked teacher about the type of planning they practice: yearly, seasonally, monthly, and daily. The rest of the items have asked about the form of planning the teachers use: a written form, mental form, or both: written and mental forms together. Questions about demographic information was also included but excluded from this report (See Appendix 1).

The reason behind measuring five domains of instructional design was that teachers are expected to plan for the whole instructional process while they teach. And this process of instruction is not confound on teaching and evaluating students (Branch, Darwazeh, & El-Hindi, 1991). In fact, this process includes five domains: analyzing and sequencing, developing, implementing, managing, and evaluating instruction (Reigeluth, 1983).

On the other hand, the real world of teaching tells us that a lot of teachers have mastered some skills of instructional design. Thus, training them on all activities of instructional design is a waste of time and effort. For this reason, the current came to identify five sub-measures of instructional design in order to determine the domain that the teachers lack of, hence to give them the training they need in that domain. By doing that, time and effort will be saved specially in this age which is characterized by rapid technological and information advances.

2- Questionnaire Validation:

The questionnaire was validated with 10 experts in instructional design who are located in six Universities: Syracuse University, The University of North Carolina at Wilmington, The University of Georgia, The Pennsylvania State University, The Florida State University, and An-Najah National University. Also 40 in-service teachers of (1-12) grades have read the questionnaire and made some changes and comments on it to be understandable from teachers' jargon. All the changes and comments that have been provided by those experts and teachers were considered. Thus, the content validity of IDC questionnaire was secured. On the other hand, the "Cronbach Alpha coefficient" was computed for the reliability of the questionnaire. It was (.91).

Procedure:

The IDC questionnaire was administered to the sample of the current study one week before teachers start to receive training on IDC. Teachers, next day of the administration, were asked to design a written plan, in the way they used to, for two lessons of their regular subjects they teach in their schools, and submit it to the author. Then, they were required to teach the two lessons in one week as needed, and to test their students in the following week immediately. Teachers who teach the same subject-mater to the same grade were asked to teach the same lessons and use a unified test, and to grade the test according to the unified model of solution. The author was reviewing the achievement tests to make sure that they measure all concepts, principles, procedures, and facts that the two lessons included. This process of teaching and testing took around ten days.

Immediately after that process of teaching and testing, teachers start to receive training on how to design instruction systematically. 18 hours were devoted for this training out of (48) hours put for the whole course. Teachers were trained theoretically and practically in three consecutive weeks. The training based on Dick and Carey's model for the systematic approach of instruction, and was taught by the author herself. by using Merrill's Component Display Theory (Merrill, 1983). Basically, teachers were given generalities of each component of the Dick and Carey's model (See Figure 2 again), then examples, practices, feedback, and a test.

Therefore, the practice section of the training was focused on involving teachers in the activities of each domain of instructional design which in sum comprised the IDC questionnaire.

In the domain of **analysis**, teachers were asked to engage in analyzing activities such as: analyzing the classroom environment, determining its constraints and facilities, determining the educational goals, describing students' learning ability, social economic class, academic aptitude etc., conducting content analysis, determining behavioral objectives, and identifying learning prerequisites etc.

In the domain of **design** (or sequence), teachers were asked to engage in designing activities such as: sequencing educational and behavioral objectives hierarchically, identifying relationship among topics, match educational goals to performance objectives; match instructional strategies to performance objectives; match performance objectives and instructional strategies to lessons content; match performance objectives, instructional strategies, and lessons content to test items etc.

In the domain of development and **implementation**, teachers were asked to engage in teaching activities such as: selecting or developing primary teaching strategies; selecting or developing alternative teaching strategies; determining cognitive strategies for supporting student learning such as organizers, questions, note-taking etc.; selecting strategies for recognizing individual differences, for motivating students learning, and for dealing with student who are above or below average; identifying available and potential resources relevant to a planned instructional episode such as textbook, periodicals other important references; selecting relevant media etc.

In the domain of **management**, teachers were asked to engage in managing activities such as: outlining a time line for accomplishing the lessons objectives; coordinating with school's principal, superintendents, administrators, teachers and parents when necessary; consulting with the appropriate specialists, supervisors, subject matter experts, business and industry groups, educational organization, educational technology experts when necessary; planning for classroom management; planning for dealing with disruptive behavior in the classroom; keeping records of students' progress, achievement, attendance, special needs etc.

And in the domain of **evaluation**, teachers were asked to engage in evaluating activities such as: developing achievement tests; developing a plan for formative evaluation; developing a plan for remedial instruction or enrichment activities; developing a plan for summative evaluation etc.

We should note here that teachers were required to submit a written report for each domain's activities.

Then, a take-home exam test was administered to the teachers by giving them a new written lesson, and asking them to do all the above activities that have learned and practiced, but now by using a new lesson.

At the end of the eighteen hours of training, the same subject-matter groups of teachers were asked to submit a written plan for another two lessons for the second teaching. Teachers were reminded to pull them out from the same unit that they taught before the training, but this time they should follow in their planning the principles they have learned and practiced during training processes.

One week later, teachers were asked to teach the two lessons in one week as needed, and to test their students in the following week immediately. As it was in the first time, teachers who teach the same subject-mater to the same grade were asked to teach the same lessons and use a unified test and to grade the test according to the unified model of solution. The author was reviewing the achievement tests to make sure that they measure all concepts, principles, procedures, and facts that the two lessons included. This process of teaching and testing took also around ten days.

After that process of teaching and testing, IDC's questionnaire was administered to the teachers for the second time, two weeks after receiving the training. Thus, four averages of scores were collected: Teachers average scores on the questionnaire: one before the training and one after. Students average scores on the achievement tests: one before their teachers received the training, and one after.

It should be noted here that teachers who teach the same subject-matter to the same grade, and form a group of three persons or more were only considered for computing the correlation between their scores on the questionnaire, and their students' test scores. The aim of this process was to reduce the variation among teachers who teach different subjects to different grades. Accordingly, the computation of the correlation has been done only on 19 teachers who formed groups with respect to the subject-matter and grade. They came in an arbitrary way as follows: 4 teachers teach Science to tenth grade, 4 teachers teach Arabic to the twelve grade, 4 teachers teach English language to the tenth grade, 4 teachers teach Arabic to the second grade, and 3 teachers teach History and Geography to the twelve grade (See Table 6).

Results

The results of this study were the following:

1- t-test for dependent samples showed a significant enhancement in teachers' planning routine from before receiving the training on Instructional Designer Competencies (M = 3.7)to after (M = 4.10); {t(29) = -2.86, p<.0077}. (See Table 1).

2- A 5x2 factorial analysis of variance for repeated measure design with two factors: One for between-subjects (Teacher planning domains: analysis, design, devolopment and implementation, management, and evaluation), and one for within-subjects (Before training & After training) showed a significant main effect for between-subjects {F(4:145) = 3.15, p<.01}, and for within-subjects {F(1:145) = 28.56, p>.0001}, but did not show a significant interaction.

The Post-hoc ANOVA by using a "Scheffe" test at (.05) a priori level of significance failed to show any differences among domains. On the other hand, it showed differences for within subjects which indicated that teachers' planning routine was enhanced from before training to after in all domains except the implementation one (See Table 2:A & 2:B).

3- A 4x2 factorial analysis of variance for repeated measure design with two factors: One for between-subjects (Teacher Planning Types: daily, monthly, seasonally, and yearly), and one for within-subjects (Before training & After training) showed a significant main effect for only between-subjects {F(3:116) = 5.41), p<.001).

The Post-hoc ANOVA by using a "Scheffe" test at (.05) a priori level of significance indicated that the annual planning (M=4.93) was practiced better than the seasonally planning (M=4.45) and the monthly planning (M=4.35), but not than the daily one (M=4.73) (See Table 3:A & 3:B).

4. A 3x2 factorial analysis of variance for repeated measure design with two factors: One for between-subjects (Teacher planning forms: written, mental, and both, written and mental forms together), and one for within-subjects (Before training & After training) showed a significant main effect for between-subjects $\{F(2:87) = 4.64, p<.01\}$, and for within-subjects $\{F(1:87) = 5.63, p>.01\}$, but did not show a significant interaction.

The Post-hoc ANOVA by using a "Scheffe" test at (.05) a priori level of significance indicated that the written form ($M=4.25$) was practiced better than the mental and written form together ($M=3.68$), but not than the mental form ($M=3.81$). For the within-subjects, Scheffe test indicated that the only mental form was significantly enhanced from before training to after ($M =3.43$ vs.4.2) (See Table 4:A & 4:B).

5- Lindquist Type 1 ANOVA with two factors was utilized **separately** for each of these independent variables: a) gender, b) years of teaching experience, c) number of training programs that the teachers had taken during in-service, d) teachers' college specialization, e) subject matter groupings, f) the level of leaning stage that the teachers teach in.

The analysis revealed the following results:
a) There was no significant main effect between-subjects for each of the above independent variables.

b) There was a significant main effect for within-subjects, the repeated measure, ranging from (.01) to (.0007) level of significance for each analysis of the above independent variables. It indicated that the teachers planning routine was enhanced significantly after receiving the training (See Table 5).

c) There was no significant interaction between the repeated measure and each of the above independent variables except for the learning stage ($p<.007$). This interaction indicated that the elementary schools teachers planning routine was increased after training, whereas the teachers planning routine who teach all grades (1-12) was decreased and vice versa before training .

6- The items that had been practiced 90% or more as follows:

Question # 26.	Develop a time line for accomplishing the course goals ($M = 4.86$).
Question # 34.	Prepare records that document student progress, achievement attendance. or special needs ($M = 4.83$).
Question # 5.	Analyze the learning task in order to identify the primary and secondary content that I plan to teach ($M = 4.60$).
Question # 32.	Develop an instructional management plan to make sure that events take place as they were planned ($M = 4.6$)
Question # 29.	Design an evaluation plan to determine students' strengths and weaknesses in mastering the performance objectives ($M = 4.56$).

Whereas, the items that had been practiced (10%) or less specially as follows:

Question # 4.	Analyze student history and characteristics ($M = 2.86$).
Question # 21.	Select the media that are relevant to implementing the course ($M = 3.06$).
Question # 28.	Consult with resources, specialists: administrators, supervisors, content experts, or people from business and industry, while I plan for the course ($M = 3.26$).
Question # 27.	Coordinate activities and events with school administrators, other teachers, or parents to manage or run the course smoothly ($M = 3.36$).

7- The "Pearson correlation coefficient" between teachers' planning routine and their students' academic achievement was almost zero ($r = -.09$) before training, whereas this correlation was improved significantly after training ($r = .51, p< .02$). t-test between the two correlations was $\{t(19) = -8.9, p>.001\}$ (See Table 6).

Limitation of the study

Before discussing the results of this study, it is worthwhile to bear in mind that the experimental design of this study was a pseudo-experimental design which might threaten, somewhat, the internal validity of this study such as history, maturation, testing, and mortality variables. At the same time, considering that the study dealt with teachers aged over thirties, and submit them to a short period of time of training (three weeks), the effects of

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maturation and history are relatively reduced if it is not controlled. In addition, the mortality extraneous variable is controlled by taking the same number of teachers before and after the training. Nevertheless, we still recommend other researchers to use true experimental design like a pretest-posttest control group design in their future studies.

Discussion

The overall mean indicated that training teachers on instructional designer competencies enhanced significantly (p>.0007) their teaching planning routine, hence, their students' academic achievement. This results showed clearly the importance for the teachers to use the systematic approach of instruction while they plan for teaching. This result is in consistence with the results of most of previous studies that had investigated the same theme and reached to similar results (e.g., Branch, Darwazeh, & El-Hindi, 1992, Martin, 1990; Reiser & Mory, 1991; Earle, 1991, 1992).

The most interesting finding of this study was the significant correlation (r = .51, p< .02) between teachers who received training on IDC and their students' academic achievement. This correlation was zero before training, and became moderate and significant after training (See Table 6).
This finding showed the importance and effectiveness of acquiring IDC skills not just for enhancing teachers' planning routine, but also to improve their students' academic achievement. Since, this is the only study that have investigated this kind of relationship, the author strongly recommends other researchers to conduct more studies to validate this result. The author also recommends the ministry of education in Palestine and in any country to submit their teachers, who still do not have any knowledge or skills in instructional design, to a training program or give them a course related to it.

With respect to the **types** of planning, results of this study showed that the annual planning was practiced most, whereas, the monthly and seasonally planning were practiced least with no differences between the annual and daily planning. This could be interpreted that Palestinian teachers do care to plan for either the whole curriculum or each lesson of it, but not for each course or unit which was expressed in a seasonally or monthly plan. This result contrasts, somewhat, to the Earle's results (1991,1992) which indicated that teachers deviated more from yearly plans and less from unitory (monthly) and daily plans. This could also be interpreted by the differences might be existed between the Palestinian and the United Sates' educational systems. Cross culture studies are greatly recommended on this issue.

With respect to the planning **forms**, the results indicated that the written plan was practiced most, whereas, the written and mental plan form together was practiced least with no differences between the written and mental forms. This result is in agreement with Reiser and Mory's ones (1991) which indicated that trained teachers on using the systematic planning techniques have focused on a written plan as well on the mental one.

Other interesting finding of the current study was that the mental form of planning was the only form which improved significantly from before training to after. This could show the training process succeeded in attracting teachers' attention to the systematic approach of instruction and letting them think about it.

Other surprising finding of this study was the significant interactions between the students learning stage and the repeated measure (p<.007). This interaction indicated that the elementary schools teachers' planning routine was increased after training, whereas, teachers' planning routine who teach all grades (1-12) was decreased and vice versa before training.

This result could be interpreted by saying that teachers who teach all grades may get confused when they plan for all grades simultaneously. Whereas, teachers who teach in a defined stage know exactly what they are going to do. Why the elementary stage not other stages? The reason could be that teachers of elementary stage can transfer the principles of instructional design more easily than those who teach in the other stages like preparatory or secondary; because they deal with less complexity of subject-matter than the other two stages. However, considering that there was one teacher in the cell of all grades (See table 5), we can not trust this result. Thus, further research is recommended to take bigger sample in each stage.

Before signing off, it is worthwhile to note that the general (F) showed a signicant main effect among teacher's practices of the five **domains**, though the "Scheffe" test could not reveal such significance. The means of design and analysis domains were higher than the implementation, management, and evaluation ones respectively (M = 4.06 vs. 4.01 vs. 3.76 vs. 3.76 vs. 3.79). These means could tell us that teachers have already had some knowledge and skills in planning instruction. Thus, it is very beneficial to measure teachers' planning routine in each domain rather than measuring it as a whole. This process could help us, as instructional designers, to give teachers the training they need in the domain they lack of.

Accordingly, instructional designers are recommended to work more on IDC's questionnaire and its five domains, so, it can be used as a diagnostic tool for identifying the domain that the teachers lack of. In this way we can save a lot of money and effort when we give teachers the training they need in the domain they lack of, rather to give them training in all domains they have already mastered some of them.

In sum, instructional designer competencies are very important to acquire by teachers in order to improve the quality of their teaching, hence, the level of their students' academic achievement. More research is greatly recommended to investigate the relationship between teachers who had instructional designer skills and their students' academic achievement by using true experimental designs like a pretest-posttest control group design.

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Tables 1 - 6 and Appendix 1 appear below.

	x	(SD)	df	t-test	P
Teachers Planning Routine Before Training	3.7	(.52)	29	- 2.86	0.007
Teacher Planning Routine After Training	4.1	(1.46)			

Table 1. t-test for Teachers Planning Routine Before and After receiving training in Instructional Designer Competencies.

Source	df	Sum of Square	Mean Square	F-test	P value
Planning Domains (A)	4	4.497	1.124	3.153	.0161
Subjects w. groups	145	51.707	.357		
Repeated Measure (B)	1	12.723	.138	28.56	.0001
AB	4	.551	.445	.309	.8715
B x subjects w. groups	145	64.593			

Table 2:A Lindquist Type 1 ANOVA Summary Table for Instructional Designer Competencies' Domain.

IDC's Domains

		Before Training	After Training	Total
Analysis	x	3.79	4.23	4.01
	(SD)	(.71)	(.51)	(.61)
	n	30	30	60
Design	x	3.88	4.25	4.06
	(SD)	(.61)	(.53)	(.57)
	n	30	30	60
Implementations	x	3.63	3.9	3.76
	(SD)	(.71)	(.67)	(.69)
	n	30	30	60
Management	x	3.56	4.06	3.76
	(SD)	(.56)	(.53)	(69)
	n	30	30	60
Evaluation	x	3.55	4.03	3.79
	(SD)	(.80)	(.58)	(.69)
	n	30	30	60
Total	x	3.68	4.09	3.89
	(SD)	(.67)	(.56)	(.62)
	n	150	150	(300)

Table 2:B Teachers Means, Standard Deviations, and Samples for Instructional Designer Competencies' Domain Before and After Training.

Source	df	Sum of Squares	Mean Square	F-test	P value
Planning Type(A)	3	13.012	4.337	5.411	.0016
Subjects w. groups	116	92.983	.802		
Repeated Measure(B)	1	1.504	1.504	1.493	.2242
AB	3	4.146	1.382	1.372	.2549
B x subjects w. groups	116	116.85	1.007		

Table 3:A Lindquist Type 1 ANOVA Summary Table for Instructional Designer Competencies' Type.

		Before Training	After Training	Total
Daily	x	4.7	4.8	4.73
	(SD)	(.70)	(.55)	(.62)
	n	30	30	60
Monthly	x	4.06	4.63	4.35
	(SD)	(1.46)	(.96)	(1.21)
	n	30	30	60
Seasonally	x	4.53	4.36	4.45
	(SD)	(1.1)	(1.4)	(1.25)
	n	30	30	60
Annually	x	4.86	5	4.93
	(SD)	(.43)	(0.0)	(.21)
	n	30	30	60
Total	x	4.54	4.7	4.62
	(SD)	(.92)	(.73)	(.82)
	n	120	120	240

Table 3:B Teachers Means, Standard Deviations, and Samples for Instructional Designer Competencies' Type Before and After Training.

Source	df	Sum of Squares	Mean Square	F-test	P value
Planning Forms(A)	2	10.533	5.267	4.642	.0122
Subjects w. groups	87	98.717	1.135		
Repeated Measure (B)	1	7.606	7.606	5.631	.0199
AB	2	3.378	1.689	1.25	.2915
B x subjects w. groups	87	117.517	1.351		

Table 4:A Lindquist Type 1 ANOVA Sammary Table for Instructional Designer Competencies' Form.

		Before Training	After Training	Total
Written Form	x	4.2	4.3	4.25
	(SD)	(.99)	(.75)	(.87)
	n	30	30	60
Mental Form	x	3.43	4.2	3.81
	(SD)	(1.27)	(.84)	(1.05)
	n	30	30	60
Both W & M	x	3.5	3.86	3.68
	(SD)	(1.45)	(1.1)	(1.27)
	n	30	30	60
Total	x	3.71	4.12	3.9
	(DS)	(1.23)	(.89)	(1.06)
	n	90	90	180

Table 4:B Teachers Means, Standard Deviations, and Samples for Instructional Designer Competencies' Form Before and After Training.

The Independent Variables		Before Tr. M (SD) n	After Tr. M (SD) n	F(df)	P
Gender	Male	3.7 (0.47) 73	4 (0.40) 73	F(1,23)=4.3	0.03**
	Female	3.5 (0.47) 7	4.2 (0.34) 7		
Years of Teaching Experience	(1-4)	3.5 (0.0) 1	3.8 (0.0) 1	F(1,22)=4.2	0.001**
	(5-9)	3.7 (1.03) 9	3.9 (1.03) 9		
	(10-14)	3.4 (0.58) 7	4.2 (0.28) 7		
	(15-19)	3.7 (0.44) 6	4.4 (0.29) 6		
	(20-24)	3.7 (0.22) 6	4.8 (0.44) 6		
	(25 - or more)	3.3 (0.0) 1	4.3 (0.0) 1		
No. of Training Programs	(one)	3.7 (0.33) 5	4.2 (0.21) 5	F(1,29)=14.2	0.0003**
	(1-3)	3.6 (0.28) 1	4.1 (0.42) 1		
	(6 - or more)	3.9 (0.0) 1	4.6 (0.0) 1		
College Specialization	Science	3.7 (0.08) 8	3.8 (0.58) 8	F(1,27)=4.1	0.035**
	Literature	3.6 (0.47) 73	4.1 (0.40) 73		
	OTHERS	3.9 (0.0) 1	4.6 (0.0) 1		
Subject-Matter Grouping	Arabic	3.6 (0.47) 8	4.6 (0.48) 8	F(1,24)=7.82	0.01**
	English	3.4 (0.69) 7	4.1 (0.28) 7		
	Science	3.6 (0.38) 4	3.7 (0.70) 4		
	Math	3.8 (0.23) 2	4.1 (0.14) 2		
	History and Geography	3.8 (0.21) 6	3.9 (0.44) 6		
	OTHERS	3.8 (0.37) 3	4.1 (0.27) 3		
Learning Stage	Elementary	3.6 (0.21) 4	4.5 (0.28) 4	F(1,29)=11.8	0.002**
	Preparatory	3.8 (0.50) 2	4.8 (0.50) 2		
	Secondary	3.6 (0.58) 73	4.8 (0.34) 73		
	Teachers teach in all stages	4.4 (0.0) 1	3.6 (0.0) 1		

Table 3: Teachers Means, Standard Deviations, Samples, F-Test, df, and level of significance for repeated Measures (Before & After Training) with respect to Gender, years of teaching experience, No. of Training programs, College specialization, Subject-matter grouping & the learning stage that teachers teach in.

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	Teachers' mean on IDC Ques. B. Trainging	Students' mean on the achievement Test B. Training	"Pearson r" between teachers and students' scores B. Training	Teachers' mean on IDC Ques. A. Training	Students' mean on the achievement Test A. Training	"Pearson r" between teachers and students' scores A. Training	The No. of students in each class	Subject-matter & Grades Level
1	2.530	7.530	-.09	2.600	8.520	.513**	(30)	Sci,10
2	3.530	8.420		3.900	6.550		(33)	Sci,10
3	3.740	8.860		4.440	9.770		(33)	Sci,10
4	4.180	7.100		3.880	8.020		(25)	Sci,10
5	3.180	10.700		3.930	9.670		(28)	Am,12
6	4.340	13.730		4.650	11.580		(17)	Am,12
7	3.060	13.440		4.830	11.670		(27)	Am,12
8	3.900	10.750		4.230	10.830		(20)	Am,12
9	3.740	7.740		4.200	6.510		(25)	Eng.10
10	3.670	8.290		3.830	8.060		(34)	Eng.10
11	4.250	9.050		4.440	9.550		(30)	Eng.10
12	3.650	9.180		3.880	8.210		(29)	Eng.10
13	3.900	11.960		4.060	12.680		(42)	H&G,12
14	2.230	11.680		3.530	8.720		(25)	H&G,12
15	3.340	10.230		3.790	10.650		(28)	H&G,12
16	4.020	8.030		4.270	10.500		(31)	Elem 4
17	3.530	11.220		5.000	12.190		(31)	Elem 2
18	4.440	9,800		4.230	11.860		(33)	Elem 5
19	4.480	10.180		4.600	10.500		(30)	Elem 3

Table 6: "Pearson r" between teachers means on IDC questionnaire and their students' academic achievement Before and After Training

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Appendix 1.

Instructional Designer Competencies' Questionnaire.

The items:

As I plan for teaching, I do the following:

1. Analyze the school setting in which the course would be delivered.
2. Review the goals for my course that are stated in curriculum guides or course manuals.
3. Determine the constraints that I may face during teaching.
4. Analyze student history and characteristics, including past academic patterns and levels, age and maturity, special aptitudes or disabilities, and socioeconomic characteristics.
5. Analyze the learning task in order to identify the primary and secondary content[1] that I plan to teach in the course.
6. Organize the course content, including the concepts, rules, procedures, and facts, hierarchically from simple to complex.
7. Determine how items of the course content are related to each other.
8. Identify the prerequisite learning or characteristics that students should have in order to learn what I plan for the course.
9. Specify performance objectives for each lesson in the course, or decide what the objectives will be.
10. Organize performance objectives hierarchically from simple to complex.
11. Match the course goals to performance objectives.
12. Select or produce the teaching methods that are essential for the course.
13. Select or produce the teaching methods that will be used as alternatives for the course.
14. Match teaching methods to the learning stated in the performance objectives.
15. Match performance objectives and teaching methods to the course content.
16. Determine the aids to thinking that are needed to support learning by the student; such as organizers, related questions, summaries, note taking, analogies, stories, or outlines.
17. Select or develop methods for recognizing differences among the students.
18. Select or develop methods for motivating students to engage in learning the course.
19. Make plans for using methods of reinforcement during teaching.

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[1] "Course Content" when used in any item refers to all the concepts, rules, procedures, and facts that might be the intended learning for a course.

20. Determine the available textbooks, reference materials, periodicals, or other resources that are suitable to a planned course.

21. Select the media that are relevant to implementing the course.

22. Plan for facilitating verbal and non-verbal interactions between the teacher and students.

23. Develop the achievement tests that would be used for the whole course.

24. Match performance objectives, teaching methods, and the content of the course to the test items that are being considered.

25. Develop or adopt evaluation procedures besides achievement tests to evaluate other student learning

26. Develop a time line for accomplishing the course goals, with a consideration given for holidays and other interruptions of the instruction.

27. Coordinate activities and events with school administrators, other teachers, or parents to manage or run the course smoothly.

28. Consult with resources, specialists (administrators, supervisors, subject matter experts, or people from business and industry), while I plan for the course.

29. Design an evaluation plan to determine students' strengths and weaknesses in mastering the performance objectives.

30. Design a plan for remedial or enrichment instructional activities.

31. Design an evaluation plan for assigning final grades.

32. Develop an instructional management plan to make sure that events take place as they are planned.

33. Make plans for dealing with disruptive behaviors in the classroom.

34. Prepare records that document student progress, achievement, attendance, or special needs.

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35. I use the above activities yearly when I plan for the whole academic year.

36. I use the above activities seasonally when I plan for the whole course.

37. I use the above activities monthly when I plan for each unit of the course.

38. I use the above activities daily when I plan for each lesson of the course.

39. I plan for these activities mentally.

40. I plan for these activities in written form.

41. I plan for these activities both: mentally and in written form.

Note: Analysis Domain =Items #1+2+3+4+5+8+9
Design or Sequence Domain =Items #6+7+10+11+14+15+24
Development & Implementation Domain =Items #12+13+16+17+18+19+20+21+22
Management Domain =Items #27+28+32+33+34
Evaluation Domain =Items #23+25+26+29+30+31

Title:

Cognitive Task Analysis: Implications for the Theory and Practice of Instructional Design

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Abstract

Cognitive task analysis grew out of efforts by cognitive psychologists to understand problem-solving in a lab setting. It has proved a useful tool for describing expert performance in complex problem solving domains. This review considers two general models of cognitive task analysis and examines the procedures and results of analyses in three domains. From the standpoint of technique, cognitive task analysis can and should be integrated into systematic instructional design. However, true integration will require instructional designers to reexamination their theories of learning with an eye toward adopting the learning constructs developed by cognitive psychologists.

Cognitive Task Analysis: Implications for the Theory and Practice of Instructional Design

Introduction

Task analysis as practiced within the world of instructional design typically results in a linear description of the job process and/or hierarchical orderings of the intellectual skills required to achieve the task. These constructs are particularly useful for defining observable tasks easily subject to top down (or bottom up) analysis. When the object of training is to move people toward expert performance in a complex problem solving task, an instructional designer relying entirely on task analysis methodologies from the instructional design literature may be at a loss. However, useful task analysis models and techniques have been developed by cognitive scientists working in the areas of knowledge engineering, ergonomics, and cognitive measurement. These techniques generally focus on illuminating the "covert heuristic" (Wilson and Cole, 1990) used by experts to solve problems, and result in a description of an expert's mental model of the problem.

Cognitive task analysis (CTA) techniques were first used by cognitive scientists studying human cognition in a lab setting, typically by having subjects (college students) work through domain-free problems such as "The Tower of Hanoi" or "Missionaries and Cannibals". Of interest to instructional designers, however, is CTA's usefulness as a method for describing the performance of people who solve difficult problems for a living. Funke (1991) identified six features common to such problems:

1) Intransparency—only some aspects lend themselves to direct observation; often one must infer an underlying state from observational data. Alternatively, the problem can be fully assessed in principle, but it involves so many variables that by necessity a few relevant ones must be chosen;

2) Polytely—multiple goals;

3) Complexity of situation—the problem involves a large number of control processes and regulatory features;

4) Connectivity of variables—changes in one variable affects the status of other variables;

5) Dynamic developments—the problem situation may suddenly change for the worse, forcing a problem solver to act immediately under time pressure;

6) Time-delayed effects—not every action show immediate results.

Three occupations discussed extensively in the literature as subjects for CTA: air traffic controllers (Means, 1993), electronics specialists troubleshooting avionics equipment-testing workstations (Lajoie & Lesgold, 1992; Lesgold &Lajoie, 1991; Lesgold, Lajoie, Logan, & Eggan, 1990; and Means, 1993), and nuclear power plant operators (Roth & Woods, 1992; Roth, Woods, and Pople, 1992), reflect these qualities.

Given Funke's characterization, among the problem-solvers' most important skills will be metacognitive strategies for selecting relevant information, prioritizing and revising goals, and working between multiple versions of the problem representation. For example, a practitioner may keep current and projected models in mind. A CTA approach provides a framework for identifying and integrating skills such as these into the overall task description.

This review of the literature considers the roots and practice of CTA, with the general goal of elucidating and perhaps expanding the notion of task analysis in instructional design. The first section of the paper summarizes the underlying theory of CTA, focusing on research in problem-solving and expertise. The following sections review the literature on CTA models and techniques and examine weaknesses of CTA. Finally, implications of the technique for the theory and practice of instructional design are considered.

Underlying theory

Problem-solving

Problem-solving theory developed within the information-processing view of cognition (see, Reimann & Chi, 1989 for a review). The terminology from this strand of the literature is also widely used in describing CTA. Initially the solver internally represents the problem in terms of its objects, actions that can be taken on objects, strategies that can be used to work on the problem, and constraints on objects, actions, and strategies. This original representation of the problem as given is called the initial state, which evolves into subsequent problem states as operators are applied by the solver until the goal state is reached. The set of all possible problem states and all possible combinations of operators is the problem space. By definition, problem solving is the process of picking a path through the problem space from the initial state to the goal state.

Expertise

When conducting a task analysis, the problem representation of an expert (or a novice-expert comparison) is of particular interest. But in complex domains expert problem-solving becomes inextricably linked with domain knowledge (Reimann & Chi, 1989, Bedard & Chi, 1992). The problem representations and operators used by experts are specific to their domain, and cannot be easily identified outside the domain. Expert performance is characterized by other consistent features. Experts' domain knowledge is broader, more interconnected, and better organized. They learn to quickly recognize recurring patterns in their domains (Bedard & Chi, 1992). As expertise grows, procedural knowledge becomes more comprehensive and automatic, freeing up processing capacity. (Means, 1988) This process can lead to a dissociation between verbal knowledge and performance as experts may not be able to easily describe what they do (Sanderson, 1989). Another component of experts' problem-solving capacity is increased memory for information in their problem domain (Anderson, 1993). Experts tend to view problems by focusing on underlying principles instead of surface features and, as opposed to novices, will impose structure on ill-defined problems. Finally, when following a means-end problem solving strategy (the process of iteratively setting and revising intermediate goals to reach a targeted end-goal), experts follow more efficient paths (Bedard & Chi, 1992).

Implications

The implications for cognitive task analysis are important. The primary goal of CTA is to reveal the problem representations and operators of the solver (operations include actions and strategies). But because domain knowledge and expert performance are linked, the analyst must acquire enough domain expertise to ask the right questions. The finding that experts manipulate domain data in higher-level "chunked" form is particularly important because people may be unable to access subordinate elements of chunked information easily from memory. In the same vein, cognitive strategies are generally not accessible to domain practitioners in the abstract, instead tending to be buried features of particular situations that are automatically applied when appropriate. Finally, experts' domain-specific patterns are another potential subject of inquiry for CTA.

Models of Cognitive Task Analysis

Most practitioners treat CTA as a fluid concept with the general practical goal of identifying an expert's metacognitive domain-organizing structures, and in particular his problem representation, whether it be propositional or an internal visual representation. (Wilson, 1989; Nelson, 1990). The actual procedure may in some cases focus on deriving the implicit rule base used to solve a problem (Ohlosson, 1990). The main focus may also be on determining the way the expert organizes domain knowledge, resulting in representations of his schemata, semantic webs, or mental representations of the problem state (Means, 1993; Lesgold et al., 1990; Nelson, 1990). However, at least two researchers have proposed formal models of cognitive task analysis.

Gardner (1985) defines the purpose of CTA as identifying the performance components, knowledge structures, and metacognitive knowledge underlying a task. Performance components are the automatic mental processes underlying all cognition, such as encoding, inference, response, and performing operations on internal representations. Knowledge structures are the network of propositions and rules that form domain knowledge. Metacognitive knowledge, in Gardner's view, is the collection of overt mental strategies people apply to a task to control higher-order planning, such as breaking the problem into parts.

Roth and Woods (1989) define cognitive task analysis as a two part process. The goal of the first stage is to define competent performance of the task, or to create a model of the problem-solving environment. The resulting *competence model* specifies "what people must be able to do to accomplish the task: what kinds of problems they must solve, what must they know and how must they use this knowledge to solve problems; what knowledge must be accessed to select goals, form intentions to act, to monitor and adapt plans" (p. 246). The competence model defines the parameters of the rest of the CTA, pointing the analyst toward the areas of the task that require study. Roth and Woods also believe that by first defining a competence model, the analyst is more likely to correctly identify sources of poor performance. The second stage of analysis derives a *performance model* which specifies how practitioners actually perform the task. It is in this phase that domain specific knowledge is elicited through a variety of interviewing and observational techniques.

These two models describe CTA at completely different, but compatible levels, which can be described in Roth's and Woods' own terms. Gardner's conception can be seen as part of a performance model of CTA, for which Roth's and Wood's conception serves as the broader competency model.

Cognitive Task Analysis Procedures

While investigators have pursued a rich and varied group of strategies to perform CTA's, the procedures can generally be grouped into three categories. These are: 1) methods for using domain knowledge to structure the analysis, 2) focus problem development, and 3) knowledge elicitation.

Acquiring domain knowledge

Before analysts can get very far, they must learn enough about the domain to be able to ask the right questions about how people do the task and to be able to understand the answers. The objective is to get a preliminary sense of "the basic concepts, procedures, range of problems and sources of complexity in the task" (Roth &Woods, p.250) — to develop a competency model that serves to structure the rest of the analysis.

As in any task analysis, one starts with the "official" version of the task by reviewing any existing materials that describe it. Beyond examining documentation, a typical approach at this stage is to interview several people who perform it. However, these discussions can tend to focus on isolated details of the task, often producing several unrelated versions or a skewed picture of its true dimensions. Roth and Woods recommend having a domain expert prepare and deliver an overview presentation first, then moving into structured interviews to add detail. A second approach is to leverage expert knowledge to define the task without specifically attempting to bring the task analyst up to speed. Means, for example, used panels of experts who checked each others' versions of domain problems so that consensus could be reached on which sorts problems were useful for study. Lesgold included on his analysis team an expert with extensive experience training novices (Lesgold & Lajoie, 1991).

Developing focus problems

After defining the range of problems, the analyst needs a forum for examining which cognitive skills are brought to bear on the problems. Rather than analyze a live task in an "online" work setting, a typical technique is to design focus problems that contain critical features of the kinds of problems faced by people performing the task. Such problems may be critical incidents, or they may be generally representative of the job task, but they must be entirely domain specific in order to stimulate the metacognitive skills and representations of the domain that are the focus of the task analysis. By studying the practitioner's approach to solving these problems, the analyst gathers information about the key skills generally required to carry out the task.

Roth and his colleagues (Roth & Woods, 1989; Roth, Woods & Pople, 1992; Moray &Rotenburg, 1989) convened panels of experts to construct the focus problem, an approach similar to the one described by Means. After convening her experts to define typical problem types, Means (1993) had her experts construct problem examples. In their work on avionics troubleshooting systems, Lesgold and his colleagues relied on their expert to define the focus problem, but his decision was informed by protocol data (see below) from previous observations of airmen working in the problem area (Lesgold et al., 1990). [1]

Knowledge elicitation techniques

Performance components. With the focus task in place, the analyst collects observational and interview data concerning task performance. The data of interest may occur at the performance component level as described by Gardner. For example, Lesgold and Lajoie (1991) measured semantic retrieval efficiency on a subtask in an effort to determine whether there were differences in the accessibility and organization of key concepts between effective and less effective beginning troubleshooters. Moray and Rotenberg (1989) collected eye-movement data as experts and novices worked on a computer simulation of a temperature control problem with relevance to power stations. From this data they formed hypotheses about the processing requirements of subsets of the task. The data allowed them to identify points at which "cognitive lockup" occurred. In this condition practitioners fixate on one aspect of the problem to the exclusion of other cues suggesting alternative solutions.

Conceptual knowledge. An inevitable goal of any task analysis is defining pertinent domain knowledge (Gardner's knowledge structures), particularly in areas where procedures have become automatic. This is largely accomplished through interviews. Although there are numerous ways to help people retrieve information from memory, only the most basic and important technique, prompting and probing, will be mentioned here by way of example. See Table 1 for a summary of many elicitation techniques.

Table 1
Cordingley's Knowledge Elicitation Techniques

Technique	Comments
Interview	All knowledge types will emerge
LaFrance questions	Reveal schemata w/6 levels of question
Laddering	Generate hierarchies of concepts
Focused Discussion	All knowledge types will emerge
Retrospective cases	Focus on procedural knowledge
Forward scenario	"
Critical incident	Often vividly remembered
Interesting cases	Reveal extremes of domain problems
Distinguishing goals	I.D. minimum features that define goal
Goal Decomposition	Means-end analysis
Decision Analysis	Assign value to each decision path
Teachback	Doublecheck gathered material
Construct Elicitation	Focus on schemata
Kelly's diads/triads	Software automates elicitation
Sorting	Forced conceptual categories
Protocol Analysis	Focus on cognitive strategies
Think aloud	Reports all thoughts during task
Eidetic Reduction	Critical self-evaluation of task
Retrospective report	Memory of thinking process--can be compared with real-time version
Simulations	Esp. useful if acquiring information about system requirements

Note. Table compiled from Cordingley, (1989).

Probes are content-free comments by the interviewer which are meant to encourage the expert to elaborate further, for example, "Can you tell me a bit more about that?" Prompts address specific aspects of the content, for example, "Who would you send that to?" Means and Loftus (1991) demonstrated that prompts which provide contextual cues are useful for decomposing molar (composite) memories for episodic events. For example, if the expert were being asked to recall a specific case of an activity performed periodically, the analyst would prompt by asking the expert to recall other activities that occurred in the same time period. Hinkle's laddering technique, described by Cordingley (1989), prescribes a prompting method for developing concept hierarchies. The interviewer prompts with "why" questions to elicit superordinate concepts, "how" questions to elicit subordinate concepts, and "other example" questions to move laterally at the same conceptual level in the domain.

Lesgold took a semi-structured interview approach to analyze avionics troubleshooters (Lesgold et al., 1990). He and his colleagues used a means-end analysis to define the problem space for a focus system fault problem. Then, based on the knowledge of the expert, they defined on paper an "effective problem space" which consisted only of those steps an expert would take plus the likely steps novices would take to move through the problem space. They developed a set of probe questions in advance for each step (or node) in the effective problem space, then presented the problem and effective problem space on paper to novices. Lesgold recorded the order in which novices worked through nodes of the problem space, asking the probe questions for each node as the novice chose that decision path. From the information he gathered, he was able to categorize deficits in novices' knowledge base. He also derived problem-solving strategies and mental models of the problem.

Metacognitive skills. To focus the analysis on metacognitive skills, one of the basic elicitation techniques is protocol analysis (Ericsson &Simon, 1985). In protocol analysis, the researcher records all the actions and verbalizations of the expert as he performs the task. From this data the analyst infers the expert's mental model of the task. In verbal protocol analysis, the analyst typically asks the problem solver to "think aloud" as they complete a task. They may audio or video tape the task and have the problem solver retroactively describe what he was thinking or doing at each step as they review the tape together. Means used this method widely to identify the skills and knowledge of troubleshooters and air traffic controllers. In the weakest version of the method, the analyst simply asks the practitioner to describe post hoc what the he was thinking as he completed the task. Other metacognitive elicitation techniques include reconstruction and asking practitioners to literally reproduce their mental representations by drawing them.

The reconstruction technique (Roth &Woods, 1989) externalizes practitioners' conceptual frameworks. The analyst briefly presents a picture or description of a domain situation to the practitioner. The practitioner is then asked to reconstruct the situation from memory. Memory distortions indicate the nature of the practitioner's schemata.

Examples of eliciting mental representations are provided by Means (1993). She asked avionics electronics technicians to draw their mental representations of a test station as they tried to diagnose a fault. This information helped her identify salient features of a complex problem representation. She drew conclusions about air traffic controllers' problem representations and planning strategies by having them draw the airspace post hoc as it looked when they completed the problem. Woods and Hollnagel (1988) also used drawings of experts' functional representations of their equipment as part of a CTA of nuclear power plant operators.

Computers as a tool for knowledge elicitation. As a final note about elicitation techniques, comparing human and computer problem-solving performance can sometimes reveal human strategies. Roth, Woods, and Pople (1992) compared human performance in a simulation of an emergency situation at a nuclear power plant to computer performance in the same situation. Two teams of experts worked the problem while the researchers collected protocol and observational data. By comparing the experts strategies to the computer's superior problem solution, Roth and his team were able to pinpoint the areas of the problem space where the experts' schemata interfered with optimal problem solution.

Results of CTA

Having performed a CTA, how can one organize the data in a useful form? The task analyses performed by Means, Lesgold, and Woods and their colleagues each resulted in a wealth of data organized in different forms.

From her protocol analyses Means (1993) created tables which related steps in the problem solution both to the specific knowledge which supported each step and to more general categories which describe the overall knowledge base required to do the job. Organized one way the data show the specific knowledge needed to do a task. Organized another way the data show which knowledge is common to various tasks. Means also tried to examine the working mental representations of her two groups of practitioners. Although she never specifies how she uses the troubleshooter's mental representations in her analysis, she used the air traffic controllers' representations to draw conclusions about using radar during training.

Woods' project comparing nuclear power plant operators' problem-solving to an expert system solution of the same problem was an interesting sidelight which arose after the expert system was well developed. Woods and his colleagues performed many CTA's during the development of the system, collecting a large body of declarative and procedural knowledge as well as experts' schematic representations of the physical systems with which they work. To define competency models of task performance, they combined these schematic images with text describing the knowledge base. Thus experts' pictorial representation of their mental models were used as an anchor to define the important goal states within the task. Performance models were then derived by posing problems that could arise within the competency model and documenting practitioners' means-end solutions.

In his CTAs of avionics troubleshooters Lesgold and his colleagues categorized the resulting protocol and interview data in primarily two ways. They identified six knowledge areas (see, Table 2) which listed all the metacognitive, declarative, and procedural knowledge required to solve the focus problems.

Table 2
One of Lesgold's Data Organizers

Information Type	Examples
Plans	Extend and test a card; trace through schematic of card.
Hypotheses	Short is caused by broken wire; ground missing from relay.
Device and system understanding	Understanding and use of external control panel; understanding of grounds and voltage
Errors	Getting pin numbers for a test wrong.
Methods and skills	Ability to run confidence check programs; ability to interpret diagrams of relays, contacts, coils.
Systematicity	Returns to point where he knew what was going on when a dead end was encountered; check path from power source.

Note. Adapted from Lesgold, et al., 1990.

They then used this framework as a diagnostic scale to compare the strengths and weaknesses of less and more proficient troubleshooters. They also superimposed novice solution paths through the problem space onto expert solution paths to simplify the process of identifying salient differences in the means-end solutions.

CTA Caveats

The benefit of CTA is clearly its rich and thorough description of task performance. However it is not without its drawbacks. The biggest problem is resource intensity. Gathering the data for a CTA will take hours of the practitioner's and analyst's time--far more than a traditional task analysis--and will generate huge quantities of data, only some of which will have broad applicability to the problem. Analyzing the data is then another time-consuming effort. As Means (1993) points out, the process of codifying and categorizing the data is highly iterative, with new conceptual categories emerging as you proceed that may require reviewing previously analyzed material.

The CTA process is fertile ground for bias and error. Roth and Woods (1989) list three dimensions that will determine the validity of CTA results:
"1) the specificity of the information being elicited, 2) . . . the fidelity or realism of the retrieval context, 3) the length of time between when the information was attended to by the expert and the time he is asked to report it" (p. 255). If the CTA lacks in any of these areas tremendous amounts of effort may be uselessly expended. In addition, complex problems will inevitably have a variety of good solution paths, and for any one path, a variety of explanations (Means, 1993). Therefore the choice of experts and solutions studied is another potential area of bias.

Finally, there is the question of how to best use the important cognitive and metacognitive data arising from a CTA, an area researchers are only beginning to understand.

By very definition, experts' mental models and strategies have been developed through the slow process of accumulating experience in their domain areas. It is completely unclear to what extent this process can be circumvented. Strategies, schemata, and organizational webs that emerge directly from domain knowledge--the powerful tools of expertise which are least subject to articulation and conscious manipulation by the expert--even if identified, may not be transferable. And if they are imposed on learners, they may interfere in as yet unknown ways with the process of acquiring expertise.

On the positive side, some lower-level cognitive strategies can be taught. For example, experts' domain specific strategies for planning and reflecting on the problem solving process will emerge from a CTA. These can be taught to novices through modelling (Brown, Collins, & Dugiud, 1989; Collins, Brown and Newman, 1990). Conceptual models such as a picture of an avionics test-station focusing only on certain pieces of equipment are another CTA result. Similar models which highlight the key features of a domain area have also been shown to aid learning (Mayer, 1989) for lower ability students. Although in Mayer's work the conceptual models used were not explicitly the working models of experts, it seems plausible that in some cases experts' models could be used productively in instruction.

Implications of CTA for Instructional Design

Similarities

A difficulty for instructional designers is that CTA procedures were developed by cognitive psychologists without reference to task analysis as described in the instructional design (ID) literature. The many similarities between the two approaches are obscured by differences in terminology and emphasis.

To note the most important similarity first, both approaches result in a hierarchical or proceduralized description of task. None of the articles reviewed here clearly laid out the proceduralized version of the knowledge uncovered by CTA. However, all of the CTA's were undertaken in the service of either expert system or intelligent tutor design. Therefore to be useful, the knowledge ultimately had to be put in a rule-based form manipulable by a computer program.

None of the knowledge uncovered by CTA is outside the range of knowledge types described by Gagne (cf. Gagne, Briggs, and Wager, 1992), whose instructional theory is perhaps the most influential outside the ID literature (Kyllonen & Shute, 1989). Because cognitive psychologists tend to work from the perspective of Anderson's ACT* theory (Anderson, 1987), they use fewer terms to describe the same knowledge types. But an instructional designer could carry out a CTA and describe the results in Gagne's terms--verbal information, discriminations, defined and concrete concepts, rules, and cognitive strategies. For example, Means' instantiated skill of avionics troubleshooters: "Knowing how P/S regulator is related to power fail indicator lights," (Means, 1993) can be recast as a defined concept: "Identify characteristics of faulty P/S regulator." Paths through a problem space, including planning and reflective steps, can easily be recast as a set of rules.

A final similarity worth considering is that between Gagne's learning hierarchies and Wood's competency model. A learning hierarchy, with its emphasis on what is to be achieved, not how, is conceptually similar to a competency model. However, where Gagne's hierarchy lists all the actions that lead to the desired goal-state, Wood's competency model lists each object that can be acted on and the actions that can be performed on that object in the service of the desired goal-state.

Barriers to Integrated Models

Given the above discussion, a question that must then be asked is, "Should cognitive psychologists conducting CTAs as part of an instructional design process be referring to the ID literature?" The answer, unfortunately, appears to be "Why bother?"

Perhaps most damaging, the ID literature is weak when it comes to addressing the importance of metacognitive skills in problem solving. Despite uncertainty about how to incorporate such skills in instruction, they have emerged as crucial factors in expert performance and are some of the richest data obtainable through a CTA. While the importance of domain-specific metacognitive skills is acknowledged by Gagne et al. (1992), they also believe that on a cost-benefit basis, ID resources are better focussed on the verbal information and intellectual skills (rules and concepts) within a domain (see, Gagne et al., 1992, p. 72). A look at Dick and Cary (1985) reveals no mention of metacognition or cognitive strategies in any form.

Secondly, cognitive psychologists have designed instruction, based on the results of CTA's, in which they provide successful remediation defined only in terms of declarative and procedural knowledge. Most notable is Lesgold's intelligent tutor, Sherlock (see, Lesgold & Lajoie, 1992, for an overview). Sherlock simultaneously addresses gaps in novices domain knowledge, domain-specific problem-solving cognitive strategies, and generic problem-solving skills in a contextualized form.

Finally, cognitive psychologists have defined a taxonomy of learning outcomes which better reflects the knowledge structures that have emerged from cognitive psychological research (Kyllonen & Shute, 1989). This taxonomy defines propositions as the simplest knowledge structure and mental models as the most complicated. The same research effort which applied CTA's to avionics troubleshooters and air traffic controllers is now poised to test this taxonomy and to systematically investigate instructional strategies based on it.

The opposite question might well be asked: "Could instructional designers benefit from a CTA approach to task analysis?" Here an affirmative answer seems appropriate. Most examples of task analysis in ID how-to texts are of tasks where the designer qualifies as an expert: introspection, simple research, or naturalistic observation are all that are required for the analysis. However, in the real world instructional designers frequently rely on subject-matter experts for task descriptions. Merely viewed at the most technical level as a collection of methods for working with subject-matter experts, CTA still adds a valuable dimension of specificity to ID's usually vague prescriptions for task analysis

Conclusion

Having traced the roots of CTA, reviewed its methods, and examined some examples in practice, it is obvious that researchers outside the field of ID are making major strides in the important area of analyzing real-world problem solving tasks. If ID is to grow, or even survive, as an interesting academic pursuit, it must find some way to incorporate and make use of this and other contributions from outside disciplines. At the very least, ID texts could incorporate CTA into the systematic design of instruction. It could be cast as a task analysis subroutine to be followed in the case of problems meeting the criteria by Funke which were presented at the beginning of this paper. Gagne et al. (1992) already differentiate the design procedure for intellectual skills from those for motor or affective skills.

However this solution begs the question to some extent. At issue are fundamental theoretical principles of learning. Cognitive task analysis and traditional task analysis, with their emphases on the practitioner and the task respectively, reflect the theoretical divergence between behaviorism and constructivism. As cognitive psychologists focus their research efforts on identifying and instructionally manipulating complex mental models, they will continue to make headway in defining instructional techniques for teaching in complex problem-solving domains. Unless ID also finds a way to capitalize on the importance of cognition in mediating task performance, it will not have the theoretical power to handle such tasks.

Footnotes

1. In general, it is a poor strategy to accept the task descriptions and solutions of one expert as a basis for examining the cognitive skills applied by others on the task, as Lesgold and Lajoie (1991) acknowledge. In doing so the analyst runs the risk of missing critical aspects of the task not articulated by their particular expert.

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Title:

Lessons in Communication: Three Contract Ethnographies

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Lessons in Communication: Three Contract Ethnographies

Abstract

Ethnography, the preferred method of inquiry of the cultural anthropologist, is currently the most widely recognized qualitative method for research. Defined as the "art and science of describing a group or culture" (Fetterman, 1989, p. 11), it provides a means of studying and understanding other groups, their values and culture. This study documents the use of a permutation of that method, called "contract ethnography," where a trained professional enters a culture for a limited period of time with a limited set of questions. In the case of this study, three programs funded by the Center for Substance Abuse Prevention (CSAP) are examined: (1) the Creating Lasting Connections (CLC) Project based upon church involvement in Louisville, Kentucky; (2) the Beyond Blue Bay (BBB) Project located on an Indian reservation in Ronan, Montana; and (3) the Child Development Project (CDP) based in public elementary schools headquartered in Oakland, California (with a second site visit to Louisville, Kentucky). Each of the two-person site-visits occurred during the third of five years of federal funding. One team member was a a senior staff member of the Washington, D.C.-based consulting firm, CSR, Inc., termed the "Site Evaluator," and the second, a person trained in techniques of contract ethnography, called the "Site Visitor." Two parallel reports were written for each project, focusing upon different aspects of the project. The first author of this paper served as the Site Visitor on each of these three projects, attempting to document aspects of the local culture and its relation to the operation of the specific program. Because each of these projects had developed its own 6-8 minute promotional videotape, this paper examines communication lessons that can be drawn from these video presentations.

The Method

Ethnography has enjoyed wide acceptance as a qualitative method of inquiry. With expositions provided by Clifford Geertz (1973), David Fetterman (1988, 1989) and others, the method has been widely adopted as a methodology for study in education, health, and other social science areas. In many ways, ethnography can be considered the "grandfather" of other qualitative methods in use. In fact, one problem of qualitative methods today is that for many people, "qualitative inquiry" is synomymous with "ethnography"(Lancy, 1993).

The strengths of ethnography come from its grounding in extensive observation over long periods of time, its adoption of the "insider's" (emic) perspective, its "value neutrality," and its ability to detect fine differences in culture. A major difficulty with ethnography is the relatively long periods of time required on location. While such grounding in the culture may be necessary to write a book-length definitive study, as this methodology has been employed by U.S. government agencies, the extensive lengths of time required have entailed expenses that are prohibitive. Deslonde (1981) reports on a nationwide study where full-time data collectors used ethnographic techniques to study the multiple sites of a national project for a full year. Eastmond, one of the authors of this paper, has been employed one-fourth time over the past 4 years as an ethnographer-in-residence to study a federally funded experiment in child development (the Comprehensive Child Development Project), at one of 36 implementation sites nationwide. To date, however, not many projects have been willing to devote that level of resources to ethnographic inquiry. Clearly, given current funding trends, there is a need for a method that allows for the same kind of qualitative insights without the huge investment in time and effort required by full ethnography.

A promising development for many situations has been entitled "contract ethnography" and involves a more focused effort over a shorter period of time. This kind of inquiry goes under several names, two others being "case study research" and "microethnography." For this paper, the approach will be termed, "contract ethnography." An important feature of this form of study, as the name implies, is the use of contractual arrangement in designing and conducting the study. The contractual arrangement calls for examination of a limited set of questions, applied to a specific program. While retaining many of the techniques and assumptions of traditional ethnography, this approach allows more rapid entry and exit from a particular project, building upon the notions of expertise espoused by Eisner (1991).

For this paper, the contract ethnographer was Nick Eastmond. When references to "I" or "we" are made, it is to Eastmond or to the particular site visit team. Other terminology used is that in current use at the sites visited, for example, both "Native American" and "Indian" are used by various people at the Montana site.

Contract Ethnography for CSAP

The studies reported here were part of a national cross-site evaluation conducted for the Center for Substance Abuse Prevention (CSAP) of 90 selected high risk youth (HRY) demonstration grants funded in fiscal years 1989, 1990, and 1991 in different parts of the United States. Each of these projects targetted high risk youth (HRY) in attempting to prevent their abuse of alcohol and other drugs (AOD). The purpose of the site visits and subsequent reports was to "understand each grantee's basic assumptions in selecting and organizing its interventions, to determine how the program operates, and to reveal factors that are viewed as critical to successful outcomes." Initially, the inquiry sought to identify 10-12 highly successful "lighthouse" projects, but after the first year this expectation was dropped, presumably due to unhealthy competitive pressures that resulted among projects.

The approach required that two outsiders visit ongoing projects during their third year of a five-year funding cycle. The two outsiders, one called the "Site Visitor" (Eastmond in this report) and the other the "Site Evaluator", spent up to 10 days visiting the site. The "site visitor" had responsibility for reporting the local culture -- issues, trends, and values -- that impinge upon the workings of the prevention project, while the "site evaluator" had responsibility for documenting the third party evaluation effort.

In contract ethnography, the investigator (here the "Site Visitor") spends a limited amount of time on site, usually one week to ten days in the CSAP projects. A set of general questions are provided by the funding agency to guide the inquiry. Typical questions would be:

- What are the magnitude, distribution, and character of the target groups [for the program] in the community?

- What are the values, culture, and norms of the program's target population? What implications do these values, culture, and norms have on the High Risk Youth program feasibility and target group participation?

- What are the major political and social issues in the community, and how have these issues affected the services and support networks existing prior to the High Risk Youth program?
(CSR, Inc., 1992).

It should be noted that investigating the questions above could provide the basis for one or more books on the subject; however, to be useful, a more truncated response was expected. While members of a community might be aware of hundreds of local issues, the Site Visitor might examine only three or four, but those would be the three or four seen as most crucial and most relevant to the project at hand. Although the people on site frequently suggested the issues they felt were crucial, the final selection of issues to highlight necessarily remained with the Site Visitor, as did editorial control of the written document.

Part of the job requirement for this kind of work is that only a specific amount of time is alloted to do the work. For the three reports examined here, the allotted number of person-days was fourteen, with one week to 10 days on site and the remainder in analyzing and writing up the results. Where information was missing, it could be supplemented by later followup telephone interviews to the site. The three reports considered here were extensive, with the number of typewritten pages varying from 27 in the edited version for the CLC Project to 74 pages (unedited) in the CDP.

These studies necessarily rely on the basic assumptions of qualitative research -- namely, that the researcher is by definition the best means of gathering information, and that judgment and expertise must be exercised in doing so. In the last analysis, however, the report is the work of a single researcher and is colored by the background and perspective of that person. The contract ethnographer attempts to be candid about observations, but also to be fair in assessing all factors, motives and constraints operating on and within a program.]

In gathering data, these studies make use of the qualitative research techniques employed by ethnography, including participant observation, interviews with persons both inside and outside of the program, analysis of grantee records and reports, and a sampling of local media sources. Questions arising in the earlier stages of the research are refined and, where necessary, revisited.

One final consideration is that here are times in contract ethnography when the questions posed by the funding agency seem less relevant at the particular site than they might be at others. In the experience doing the CSAP contracts, when a conflict arose between the prepared questions and the contract ethnographer's instincts on-site of what was important, it was always possible to pursue the researcher's questions. While the funding agency might fault a report on omitting an answer to a question (and simply saying "Findings indeterminate" or "This answer is covered in Section X in the report" would be sufficient), in no case did the funding agency raise questions as to the relevance of the findings provided.

When the report did get back to the grantee, after extensive editing by the consulting firm and perusal by the CSAP project officer in Washington, there could be matters of fact or interpretation that would be negotiated between the Site Visitor and the grantee. The procedures for "member checking" advocated by Lincoln and Guba (1985), where stakeholders conduct a preliminary reading of the draft and negotiate the acceptable version with the qualitative researcher, were not acceptable to the funding agency and were not followed here. Because continued funding did not depend upon anything in either the Site Visitor or the Site Evaluator reports, and because the project officers took the stance that they wanted the unedited account of site visitors straight from the field, the kind of negotiation with the grantees over report content was curtailed.

In no instance did the kind of conflict reported by Bell and Jankowiak (1992) surface in this work. These anthropologists report a persistent difficulty in contract ethnography work when a local person, perceived as an expert by the community, clashes in interpretation with the visiting contract ethnographer ("the folk expert vs. the ethnographer). A reason for this lack of conflict may have been the mandate provided by the funding agency, putting the outsiders in a position of less vulnerability, combined with the reporting requirements that introduced a time lag between the site visit and the grantees receiving the report. Because the reports have not yet been made public, to say nothing of being widely disseminated, there has been little conflict to date over findings. McKenna (1994) has reported on the kinds of role conflicts that this kind of work poses for persons trained in traditional ethnography.

Reports on the projects used a variety of methods of analysis and reporting, to include (1) extensive use of photographs taken on site and in the local community; (2) maps of the larger geographic area and of the particular project sites; (3) cartoons, news clippings, sometimes drawn from the project's own "clip file", what Fetterman calls "outcroppings"; and (4) charts and diagrams similar to those advocated in Miles & Huberman, 1994. Examples of the latter are shown as Figures 1 and 2 of this paper, patterned after the "Case Dynamics Matrix" (pp. 148-151). These figures provide a more efficient means of comparing the three projects under consideration.

Introductory videotapes. The contents of the project videos will be described in the sections that follow, but at this point it is necessary to state how and when they were encountered, since that event varied for each project. For the first project, the CLC in Kentucky, the video did not exist at the time of the site visit in 1992. It was a bit of additional information gathered two years later at the time of the site visit to the Jefferson County-based CDP Project, also located in Louisville. Consequently, the CLC video, unlike the other two, was only viewed after-the-fact, after the Site Visitor report had been written. The video for the BBB project in Montana was first shown to the site visit team during a staff meeting on the second day of the visit. Because the video was an artifact that could be taken away and examined later, it became an important source consulted in completing the Site Visitor report. The CDP video was first mentioned in conversation during the site visit in Louisville, flippantly as "Our six minute video that really takes 8 minutes." However, it was not something that we actually viewed until our visit 2 weeks later to the DSC headquarters in Oakland, California. At that time, we watched it with the project's Research Director as an introduction to the concepts behind the project. Again, the video was an artifact that could be taken from the site, and it was a source reviewed in completing the Site Visitor report.

In the analysis of the project videos described in the remainder of this paper, the key issues were identified by three people: the Site Visitor (Nick Eastmond), a graduate assistant for qualitative research (Tamara Walser), and a Native American co-presenter and graduate student in Instructional Technology (Reba Teran). While watching the project videos, each person identified issues individually, but these were discussed collectively afterward to determine 2-3 ones to highlight. This event occurred well after the writing of the three Site Visitor reports.

The Projects

CLC Project: Louisville, Kentucky

The first project studied was the Creating Lasting Connections (CLC) Project in Louisville, Kentucky, with the site visit taking place from July 25-31, 1992. CLC is a project undertaken by COPES, Inc. (Council on Prevention and Education: Substances, Inc.), a nonprofit organization providing alcohol and other drug (AOD) prevention services in the Louisville area for over a decade. Working through the congregations of local Protestant and Catholic churches in both the African American and White communities, the project set up recruitment teams and later training sessions for both parents (24 weeks) and teenage youth (8 weeks). The sessions focused upon parenting skills and improved communications and culminated in the convening of joint activities where sharing between parents and their teenagers could take place.

As outsiders, the site visit team attended training sessions at both rural and urban sites, to include a planning meeting of the congregational team responsible for implementing training in the inner city area of the Louisville West End. The team interviewed youth, parents, staff and advisory council members, as well as access project records and research reports. Important issues summarized in Figure 1 are described in more detail as follows:

(1) **Safety net philosophy**: The project believed in building positive communication experiences between parents and their teens. However, given the possibility of opening up major conflicts and then lacking the resources to handle them, the CLC project had retained the part-time services of a counseling psychologist. Any workshop participant failing to attend a session would receive a follow-up phone call to insure that any lingering problems could be dealt with through counseling. The motto was: "We don't pick scabs," i.e. we don't open past wounds and then lack the means to remedy the situation.

(2) **Strong leader:** The project's Executive Director, Mr. Ted Strader, was well known in drug abuse prevention circles as a person with strong ideas and plans to carry them out. During the first day on site, this model for strong leadership was apparent. The project, in fact, had served as a training ground for prevention professionals, studying under Mr. Strader and then being hired off by other agencies. The down side of strong leadership was that some people reacted personally against this approach, and so there were some antagonistic forces in the community to be reckoned with. People involved in the program, however, developed strong feelings of loyalty both to Mr. Strader and to the project.

(3) **Resiliency factors of church attenders:** Because this project drew upon members of existing church congregations and because involvement with organized religion is considered as one "strengthening factor" in predicting probable involvement with alcohol or other drugs, it could be argued that this project was working with people predisposed to succeed. However, interviews with many participants provided convincing evidence that the AOD struggle was a major one for them or for their loved ones. The CLC Project staff members' argument was that beginning with one factor in their favor meant that families would more likely stay through to completion with the intense program (24 weeks of evening meetings -- one per week -- for parents, 9 weeks of similar meetings for their teenagers, with meetings lasting 2-3 hours each time). Working with the members of the congregations seemed to provide an effective way of obtaining and maintaining loyalty of participants. Using this ingenious approach secured the willing participation of congregation members. Pastors and clergy of the churches saw CLC involvement as a way to prevent AOD problems and at the same time build feelings of unity among congregational members.

CLC Project video: The introductory video for the project was produced and directed by the Project's Executive Director, Mr. Ted Strader. Some of the most convincing arguments in favor of the project were provided by direct statements by Mr. Strader. Other parts of the video included actual footage from training sessions involving parents sharing feelings of both love and concern for their children. The emotional impact of the testimonials is strong. Viewers quickly perceive the strong commitment of participants toward the value of the project and its positive impact on their lives.

The presentation may cause some individuals to question whether they could be that open and forthright about personal family problems, but the modeling from the people pictured suggests that many people have benefited from these sessions. Another concern is whether the project will be in existence long enough to handle whatever problems were uncovered. One lasting impression of this site visitor could be paraphrased in Mr. Strader's words during an interview: "This project is here to stay. We have been here a decade, and regardless of the funding we receive from the Feds, we will be here for at least that long in the future." That argument seemed to be a powerful one in convincing both ministers and lay members that this project had a long-term commitment to AOD prevention.

Beyond Blue Bay Project: Ronan, Montana

The second site visit, November 7-13, 1993, was to the Beyond Blue Bay (BBB) Project on the Salish-Kootenai Reservation in northern Montana. The current project built upon the legacy of a previous program of substance abuse prevention at the Blue Bay Healing Center on Flathead Lake. In the followup project (BBB), however, the program's emphasis was upon community development activities in six of nine reservation communities, with plans in place to expand to the remaining 3 communities in the final project years. The program attempted to strengthen resilience factors based in the traditional values of the Native American community, helping youth gain a more clear understanding of their heritage and better appreciation of their cultural roots through a variety of activities.

In addition to the Site Visitor and Site Evaluator, a Navajo woman, Trisha Poleski, was part of the site visit team. Although she had never visited this particular reservation before, her insights into the problems faced by Native Americans and her help in sensitizing the other two outsiders was invaluable. She was frequently able to examine cultural practices on this reservation in light of her own experience with the Navajos and suggest a new way of looking at the particular situation. She was also able to make suggestions on the draft report that made substantial differences in tone and content.

BBB Project Issues

Issues that surfaced during the visit, worth consideration now were as follows:

(1) **Community/tribal divisions**. During the early 1900's the tribal lands of the Flathead Reservatrion were opened to homesteading, with the result that Caucasians now outnumber Indians by a ratio of 3:1 (The 1990 census lists 21,259 persons living in the Flathead Reseervation area, and of these 5,130 or 24% are listed as Indian). From a reading of two local papers, the Lake County Leader in Ronan, with a primarily white audience and the Char-Koosta News in Pablo, read mainly by the Native American community, it was clear that community divisions exist and that the points of view of the two groups are often quite different. In addition to those differences, the combining of the two tribes, the Salish and the Kootenais, appeared to be a historical move on the part of the U.S. Government. The two groups have different languages, different tribal customs, and often different outlooks on their common issues. Designing a project that could include elements of both tribal groups, as well as both Whites and Native Americans, which this project has attempted to do, should be considered a major feat. In many ways visible to us as observers, the project was able to benefit all groups. For example, community development efforts were conducted in both predominately Salish and Kootenai area. Programs like the "Soaring Eagles" drumming groups for youth were open to both Native American and white youngsters. The survey of drug and alcohol use among teenagers, conducted by a California consulting firm and funded by the project, had purposely worked through the public schools to obtain results that would be useful to administrators in schools for both whites and Indians.

(2) **Fostering Native American culture in small populations**. Both Salish and Kootenai tribes had their separate cultural centers, and elements of the BBB Project were organized to foster

their growth. It became clear that these languages, particularly Salish, was now spoken by only a handful of people, and that unless work was done to teach it to the youth, that these languages would completely die out. Because of Bureau of Indian Affairs and other government policies during the 1950's, the "melting pot" notion, encouraging (and enforcing) assimilation into the Anglo culture at any price, the price of survival for many was turning their back on Indian ways. To combat alcohol and other drugs, a sense of heritage is seen by these people as a particularly effective factor in resiliency. Learning how close these languages were to complete extinction put a note of urgency in the attempts to build language skills and foster cultural appreciation among the youth.

BBB project video: This filming was completed by a camera crew from the University of Wisconsin, while filming a longer documentary. Project staff used a short segment of the longer production as a way to represent their project to outsiders. Having outsider narration but tribal members testimonials enhanced credibility. The emotional impact of the video is strong, emphasizing the devastating effects of alcoholism among the local people and pointing to the Beyond Blue Bay Project as one ray of hope in turning the situation around. The project provides persuasive testimonial of how the cycle of negativism and shame, reinforced by alcoholism, can be broken. Its emphasis upon healing, through traditional Indian ways, suggests a positive basis for action.

The Child Development Project: Oakland, California

The third project, the Child Development Project (CDP) of the Developmental Studies Center based in Oakland, California, operated through the elementary schools in six locations nationwide: three in California and three funded by CSAP in White Plains, New York; Dade County, Florida; and Jefferson County, Kentucky. The program trained teachers in three innovative practices: cooperative learning, literature-based writing, and developmental discipline. The project worked to train teachers to use new and more democratic teaching methods to build responsibility in students.

Our site visit went to the two schools implementing this model in the Jefferson County School District in Louisville, Kentucky (March 12-17, 1994) and then to the Developmental Studies Center in Oakland, California (March 22-25, 1994). The visit to Jefferson County was timed to coincide with training for teachers in aspects of the CDP model. Most impressive in this training was the way that local teachers, designated as part of the implementation team (I-Team), were capable of conducting a complex workshop for their peers.

The CDP was the largest and most fully developed of the projects visited. The staff in Oakland was impressive in both their credentials and dedication, acting on a scale of curriculum reform that is rare in public education. The program proposed is extensive and sophisticated. Most teachers interviewed were enthusiastic about it, for its prosocial values and its emphasis upon creating a "caring community." Values of free expression, mutual respect for members of diverse groups and community service were evident. But becoming expert in its implementation is not a trivial task; to teach in this way requires extensive training and practice.

Issues:

Specific issues examined were:

(1) **Interface of the Project with KERA.** The schools in Kentucky are undergoing an extensive program entitled the Kentucky Educational Reform Act (KERA), fostering ungraded primary grade classes and extensive testing of student progress. The program is complex, but provides each school with specific goals for student achievement and a "carrot and stick" approach to make schools accountable. Schools meeting or exceeding their goals are given more latitude in governance and are provided with extra funding to be used in ways the teachers specify. Schools not meeting their goals are required to develop a plan for turning the achievement patterns around, and if continually unsuccessful, may have new leadership imposed upon them from the outside. Implicit in the KERA reform is the notion of progress, that each year's students ought to be progressing more closely toward the ideal level of achievement. Thus, the goals are engineered to become progressively higher with each school year.

The CDP project has been implemented independently of, and at times in spite of KERA. Where KERA is specific on goals but leaves the program to reach those goals up to the educators, CDP provides a concrete set of steps to make education better. At the time of the site visit, both project schools had been cited as "meeting goals," while one of the two comparison schools had not. While not billed as a panacea for KERA, CDP has been accepted by the Jefferson County School District as worthy of expansion to 26 elementary schools beyond the original two at the time of this site visit.

(2) **Recess time for children.** At the schools visited for this study, in part because of concerns about liability for children left unsupervised on the playground, the current school policy encourages teachers to take their children outside for a supervised activity for 20 minutes during the day, but otherwise does not allow time periods for free play. While this policy is privately opposed by many CDP staff from California, it illustrates the limits that school-based program originating from outside of the state must abide. Apparently, the same policy regarding recess is in effect in the project schools in Dade County, Florida, although they were not visited in doing this report. "Because the children have grown up not knowing about recess," noted one staff member, "they don't know what they are missing." There are times, however, when instruction could probably be more effective if the children were able to take out time for free play.

(3) **Fidelity to the project model.** As mentioned above, in the time since the site visit, Jefferson County District has chosen to expand parts of the model to 20 additional schools and all of the model to 6 new schools. Because the behaviors expected on the part of teachers are complex, and a degree of encouragement and coaching is required, the rapid expansion will test the abilities of the I-Team members, since they now become the trainers, and the administrative staff locally and in Oakland. While being recognized as worthy of massive expansion is certainly commendable, the new phase will test logistics and training capacity to the limits.

CDP Project Video:

This introductory video, entitled "Creating Caring Communities of Learners," differs considerably from the two previously described. Where those for CLC and BBB rely upon testimonials, this one simply shows children learning in a classroom where the CDP model has been implemented. The close-up views of children actively engaged in learning is most convincing, with camera work that is remarkable in catching of subtle elements of conversation between children working as partners. The feeling conveyed is of a calm, nurturing atmosphere, the kind of setting that most parents would want for their child. The video leaves the observer with the unstated questions: "Is it possible for every child in school to have this kind of positive experience?" and "Could educational reform really provide this kind of education for all children, in a setting that seems to minimize the negative side of competition?" While a major portion of CDP Project effort has gone into the training and coaching of teachers, the video's focus upon the children's learning shows convincingly what the ultimate result of this project is intended to be.

Overall communication lessons.

Several lessons can be drawn from a close analysis of the introductory videotapes for these CSAP projects:

1. **Prevalence of video.** As a beginning, it is noteworthy that each of these projects had chosen independently to develop an explanatory video about their project. There was apparently no mandate from Washington or program incentive of any kind, but the leadership of each of these projects felt the need to tell its own story using a video format. That finding may say something about the expectations of visitors to federally funded projects in the 1990's, when video technology is within the range of most budgets and when the primary information source for many people is television and video. As one project administrator stated: "Our videos have become an increasingly important part of our efforts to describe the 'vision' over the years. We have never been able to convey what we are about as clerarly in words as it comes through seeing it 'in action.'" Certainly this medium allows a representation of the project in dimensions that are not possible with brochures or research reports (which all three projects had as well).

2. **Impression management.** The project videos should be seen as a form of "impression management" that all of us engage in, putting our "best foot forward" as we are introduced to new people or shown in new situations. This process should not be construed as being dishonest, but rather as being

discrete and selective of the details to present in introducing the project and in what order. The projects clearly want to tell their stories, and they do so by assembling a collage of video impressions for the newcomer. They are accurate in their portrayal of people and events in the sense that they attempt to be truthful, but producers generally work to convey the positive aspects of their projects. The negatives and caveats can come later, for the person who cares enough to investigate in more detail.

3. **Selection of issues to highlight**. The issues brought out in the videos are sometimes similar but often very different from those reported by the contract ethnographer after receiving a week or more of exposure to the project on site. In only one case, the BBB Project in Montana, could it be argued that watching the project video had some influence on issue selection by the Site Visitor, since the viewing occurred early in the site visitation process. Differing views on the issues are to be expected, although if the aim is to represent the project from an "emic" or insider's perspective, one would expect that there would be some congruence between issues selected. As can be seen from Tables 1 and 2, there is some convergence in issue selection, notably with the BBB Project, but possibly more divergence in issue selection than one might have expected. However, in some cases, the differences may simply reflect word choice and semantics. For example, for the CDP Project the issue of schools being overly competitive is the essential question behind the concern with the Kentucky School Reform Act (KERA).

4. **Emotional tone.** In each case, the message contained on the video provided an explanation but had clearly been designed to hook the viewer emotionally: in CLC with the power of honest expression between teenagers and their parents, in BBB with the gravity of alcohol's devastating effects in Native American populations, and in CDP with the excitement of children learning cooperatively in an enriched educational environment. There is little that could be called "preaching". The people speak for themselves in convincing ways. It would be difficult to watch these videos passively, without experiencing some emotion. Each in its own way works at persuading the viewer that the perspective of this project to AOD prevention is valuable.

Notes:

The reports described herein were completed with funding from the Center for Substance Abuse Prevention (CSAP). The authors wish to express appreciation to the Project staff on each of these sites for their hospitality and openness, as well as permission to use the videos from their respective projects. CSR staff members Anne Kennedy, Chris Ringwold, and Ping Yu served as Site Evaluators to the various sites, and their insights shared in conversation and in writing were invaluable in forming these conclusions. And finally, Drs. Michael Reed and Sherri Aiken were instrumental in obtaining the permission for this reporting to occur.

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Figure 1: Summary of Three CSAP Projects

	CLC Project Louisville, Kentucky	BBB Project Ronan, Montana	Child Developm't Proj. Oakland, California
Sponsoring Agency	Catholic Diocese of Greater Louisville Area, Protestant groups	Confederated Salish Kootenai Tribal Council	Deveopmental Studies Center, an independent non-profit agency
Target Population	Youth aged 12-14 and their parents	Members of 9 communities on the Flathead Reservation (adults & youth, Anglo & Native Amer)	Students in grades K-5 and their teachers in selected schools (California, Kentucky, New York, & Florida).
Intervention	Working through congregations, groups of teenagers & their parents take part in workshops on communicaton skills, parenting, AOD refusal skills	A planning group for each community designs activities for youth & parents: fostering Native American culture, & enhancing self-reliance skills	Teachers receive extensive training in cooperative learning, literature-based writing, and developmental discipline. They teach using these skills.
Issues raised	-- The need for a "safety net" after exposing problems. -- The effects of a strong leader. -- Resiliency of people active in their church group.	-- The fostering of Native American culture in small populations. -- Community/tribal divisions. -- Effectiveness of outsider programs.	-- Interface of project with KERA (Kentucky Educational Reform Act). -- Provision of recess time for children. -- Project fidelity to a complex model, esp. during expansion phase.

Figure 2: Summary of findings from Project Videos

	CLC Project Louisville, Kentucky	BBB Project Ronan, Montana	Child Development Project: Oakland, CA
Intended Audience	New participants in Family Networks	U of Wisconsin & PBS viewing audience	Stakeholders: Board, teachers, parents.
Key elements	Testimonials from participants. Viewers participate in ongoing training program. Emotional impact: Real people are helped.	Awareness of dimension of existing problems: alcoholism, suicide, denial, shame, discrimination. Emotional impact: effects devastating.	Examples of cooperative learning in younger & older elementary grades. Emotional impact: soft, soothing pace can lead to a "caring community".
Main Message	AOD prevention works, esp. when: -- planners are professionals -- Genuine caring and sharing exists -- Honest effort solves problems.	Solutions come from within the group and are based upon Native American traditional ways. Tribal history is a source of pride and AOD resiliency.	Cooperative learning can be effective if handled by a skilled and caring teacher. These strategies help children grow up more adjusted, healthy & happy.
Issues raised	-- Can this program be effective with all kinds of people (esp. shy or withdrawn)? -- How long will the Project be prepared to support solutions to family problems?	-- How can the cycle of negativity & shame be broken? -- Can outsiders help a situation that has been the result of centuries of broken promises & neglect?	-- Is present schooling too competitive? -- How can children learn from visual & other experience? -- Can school experience be better?
Special elements	Group meetings catch the emotion of parents and children sharing feelings about each other.	The emphasis upon "healing" provides a more positive basis for action. The need for adults to "model appropriate behavior" for youth comes out clearly.	Close-in views of children working on engaging lessons provides excitement with their curiosity and basic innocence.

Title:

Planning for Success: Considerations for Managing Dissemination of Training Technology

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ABSTRACT

This paper summarizes the results of a study examining the implementation of a computer-based trainer in a US Army Advanced Individual Training center. Interviews, document analysis, and participant-observation were used to identify factors that influenced potential adopters to accept or resist the new trainer. Comments from planners & administrators, technical support personnel, subject-matter experts (instructors), instructional developers, and students were analyzed for common themes affecting the adoption/rejection decision. Nineteen factors were identified, focusing on different situational entities (i.e., other participants, the system itself, external organizations, leaders of the implementation, and the bureaucracy). Results suggest four critical issues for planners to consider to maximize the positive impacts of each factor throughout the dissemination process. Recommendations for addressing these issues are offered to administrators, instructional technologists, and change agents.

INTRODUCTION

United States Army training centers have used instructional technology throughout their curricula for many years. This was a natural development in an organization dealing with many technical disciplines rooted in electronics. Frequently, dissemination of this technology proceeded smoothly, and promoted more effective learning. Sometimes, however, it produced failures as spectacular as any in the private sector. Likewise, as in business and academe, initial attributions of these failures to poor system quality or incompetent personnel ultimately fell under the onslaught of contrary data. Since previous research focusing on instructional effectiveness and other system characteristics was often inconclusive (sometimes giving high marks to a system that failed miserably), another approach was needed.

The approach selected, diffusion research, recognizes that even innovations of proven effectiveness can fail if their intended users will not commit to their success (Wellin, 1955; Mosteller, 1981; Rogers, 1983). Thus, it is concerned with the human factors which facilitate or hinder this commitment.

The diffusion paradigm breaks down some of the philosophical barriers between qualitative and quantitative methods. Its roots are qualitative, and it often makes use of in-depth interviews, document analysis, or participant-observation (Rogers, 1983). These tools are especially useful in this context, since the objective is to gain insight into the concerns of the individuals who interact with the innovation. At the same time, diffusion research does not dismiss quantitative measures, often using correlation to associate independent variables with innovativeness, rate of adoption, etc. Likewise, diffusion scholars may use statistical techniques to analyze possible trends represented by their data (Fullan and Pomfret, 1977; Berman, 1981).

Many studies of both types have been conducted, providing a rich framework for comparison that can help overcome the weak generalizability associated with case st do the key factors in a military training setting differ from those of the civilian educational settings explored in past research? This required comparison of the findings to existing frameworks.

METHOD

This study employed a qualitative perspective. The adoption/rejection decision is one that is intensely personal (Rogers, pp.20, 21). Even if it is assumed that the same set of factors underlies it for all people, the way each individual perceives those factors is likely to vary considerably. Since it is ultimately the potential adopter, not the change agent, who will decide whether to adopt or reject an innovation, this study had to examine these individual perceptions to offer meaningful guidance to future dissemination efforts (Burkman, pp.439, 440, 442).

Unfortunately, a quantitative approach to this examination was problematic. Statistical measures of observed behaviors or results are almost certain to be more representative of the researcher's cognitive structure than the subjects' because it is the researcher who selected the variables to be measured. Similarly, surveys may pose questions in a way that does not correspond to the subjects' way of thinking about such things, and may have difficulty detecting behaviors that the subjects would not be inclined to brag about. Perhaps most important, for the study to identify interrelationships between factors, it was essential that factors be described in the potential adopters' own terms, as the relationships of interest were those that existed in their minds. A qualitative approach offered the most effective means of accomplishing this end (Martin, 1988, pp.3, 4).

Participant Selection

One might imagine that what is important might vary, depending on each individuals' role relative to the trainer. To test this hypothesis (and to protect reliability from its potential effects), the participants were selected from the categories suggested by Garland (1991, p.255). These include management, information systems technologists, subject experts, instructional designers, and learners. For each category, individuals were selected whose relationship to the BMMT fell within that description. These people were approached about being interviewed and, as part of this conversation, asked who else was involved with the device when it first got started. This procedure was repeated until no new names were generated. This completed the participant selection process, except for students, and generated twenty-two names.

Representing the student perspective proved more troublesome. The procedure employed to select other participants was intended to obtain 100 percent coverage of those personnel still present. For students, this was neither possible (the last ones having graduated well before the study began) nor practical (literally hundreds being present at any one time); consequently, an alternative selection strategy was used.

Selection of students began with the assumption that their perspective remains relatively constant across time (the system is always new to the students). The major weakness of this assumption is that, during implementation, the students were faced with instructors for whom the system was also new. This threat was countered by including participant-observation logs from four trained observers (including the author) who participated in early classes. Actual students were then selected using a stratified random sampling technique, with two selected from each available class, for a total of sixteen. One selected student from each class had used the resource suite (a source of remedial instruction), while the other had not. Together, these methods were intended to ensure that perspectives were provided that reflect the full range of instructor teams and instructional approaches for the system. They also ensured that students who had trouble with the course were represented equally with those whose achievement met or exceeded normal levels.

Data Collection

As already implied, this study is an historical retrospective, as the BMMT was implemented approximately two years before it began. Since this prevented the use of participant-observation (other than that recorded in historical documents), the primary method of data collection was the in-depth interview. This method, as described by Bogdan & Biklen (1992, pp.2, 3, 96-101) uses a few general questions to orient the discussion, but generally allows the interviewee to talk about what (s)he sees as important. That is, after all, the objective (Martin, p.6).

The most specific guidance was reserved for the introduction, and for the demographic questions. Before starting this portion of the interview, a few minutes of shop talk were used to help relax the participant, and to make the interview less like formal questioning and more like an everyday conversation. The interview itself consisted of two core questions: Tell me about your involvement with the BMMT when it first got started, and Tell me about yourself. Once each question was asked, the interviewee was allowed to talk everything out before a series of more specific, semi-structured questions under each core question were asked. The use of these questions helped in the comparison of responses from different participants. The interview ended when the interviewee ran out of things to say. Demographic questions were reserved for last so the interviewee would be more relaxed. This strategy was selected under the assumption that beginning with demographic items would focus the interviewee on the fact that this was a research interview, perhaps altering the nature of the conversation.

To help ensure accurate representation of each interview, a tape recording was made of the session (after securing the interviewee's permission). For those who choose not to be recorded, field notes were taken directly. In either event, the interviewee was assured that all data collected would be held in confidence, and would not be reported with names or other identifying information.

The major weakness of an interview strategy under these circumstances is that it relies on participants' recollection of events and their reactions to them. This required the use of additional data sources for triangulation. Fortunately, the military bureaucracy is well known for generating a volume of historical documents, which served as a rich data source representing several points of view. The most common of these was the official point of view of the school hierarchy. Documents originated at each echelon provided a glimpse at coordination that occurred during the process, and various viewpoints on the device itself. Besides the official perspective, records of the evaluation organization within the school provided professional-grade qualitative data from focus groups conducted during implementation. As these records described the feelings and concerns of participants during the implementation, recorded at that time, they served as a useful cross-check for interview data collected during this study.

Coding and Analysis

Some degree of reflective analysis during data collection was inevitable, as analysis-in-the-field is an essential part of the qualitative tradition (Bogdan & Biklen, p.154). This consisted chiefly of the emergence of coding categories during the study, leading to increased attention paid to particular comments occurring during an interview comments that frequently reinforced a tentative category or suggested the emergence of a new one. Occasionally, such informal analysis also alerted the author to additional questions, new data sources, or differing perspectives of potential adopters.

Primary data analysis, however, occurred toward the end of the study. In part, this was to preserve energy and time for the tasks of establishing rapport and getting on in the field, as suggested by Bogdan & Biklen (ibid.); in part, it was to ensure that the perspectives gained from analyzing early interviews did not limit the scope of inquiry in later ones.

This analysis process began with transcription of interviews. At this time, the tape recorded (or manually recorded, via field notes) interviews were entered, with the various classes of documents discussed earlier, into journal format on a computer. The data were then reviewed, as a whole, to formalize the initial coding categories discovered during data collection. This use of open coding facilitated the broadest coverage of the data.

Once the core categories were extracted in this fashion, the study shifted to axial coding to explore them in greater depth. This portion of the process focused on identification of examples for each category from the data, and occasionally the perception of new core categories that more closely fit the observed phenomena.

RESULTS

Results of the study fall into two sections, associated with initial and subsequent rounds of analysis. In the first round, factors extracted from participant comments were organized into categories, and general impressions of findings were formed. In the final round, these categories and impressions were examined to identify major themes, or critical issues, that could be acted upon by planners and administrators.

Factors and Factor Groups

Initial coding identified nineteen factors comprising five major groups. These focused on how participants perceived certain characteristics of the different entities involved in the implementation. Such entities included other participants, the system itself, external organizations, leaders of the implementation, and the bureaucracy.

Participant Factors

These factors describe how potential adopters own characteristics, and beliefs about those of others, affected their perceptions of the system. Participant type refers to the role of the individual with respect to the innovation (e.g., management, instructors, etc.). Some comments reflected participants views of the effect of others roles on their perceptions (e.g., The command group just didn't understand what the instructors needed this thing to do). As expected, however, its greatest impact was the effect of each participants own role on the factors that affected them. The individual's role was also found to impact less on what factors were important than on how those factors were viewed. For example, individuals from all roles talked about system quality and gains (or losses) associated with adoption. In doing so, however, senior personnel focused on its impact on students, while mid-level personnel emphasized their responsibilities for the innovation itself. Instructors highlighted its effects on their interaction with other individuals, especially students, while students themselves considered what the innovation required of them. Other factors in this group included participant background, referring to whether an individual was considered a Morse subject-matter expert, competence, describing perceptions of co-workers abilities to perform their system-related duties, and views of change, relating to a participants orientations and reactions to change overall.

System Factors

This second set of factors addressed potential adopters' views of the trainer itself. Quality refers to a participant's perception of the trainers merit (e.g., poor, fair, good). Net Gain describes perceptions of this merit in relation to that of the previous system (e.g., worse, equivalent, better). These factors were surprisingly distinct, i.e., several participants felt that BMMT was a poor-to-fair system because it coddled students, yet these same individuals described it as much better than its predecessor, and therefore supported it. A final factor of this type, lessons learned, refers to a participantís impression of how the teachings of experience were incorporated into the new system and its surrounding philosophy.

External Organization Factors

Another common theme described dealings with outside organizations, such as hardware and software vendors. Capability describes a participants views of the outside organizations technical capacity to perform according to the stated requirements. Motivation covers perceptions of the goals that guided the outside organizations planning and actions (e.g., the most profit with the least effort vs. genuine concern for improving the learning process). Finally, attitude refers to a participants impression of the tone of interaction with representatives of the outside organization (e.g., condescending, hostile, cooperative).

Leader Factors

One of the most pervasive factor groups relates to the characteristics of the implementation efforts leadership, as seen by the potential adopters. Continuity describes participant views on the consistency of the implementation strategy as the effort progressed. Comments showed that personnel at all levels had difficulty adjusting to the implementations new personality when key leaders retired or were reassigned during the effort. Qualifications refers to a participants awareness of the background of the implementations leadership, and how they felt this affected leaders ability to manage the process. Involvement addresses the potential adopters perceptions of the leaderships level of interest in and attention to the implementation.

Bureaucracy Factors

This final set of factors reflects the Defense bureaucracies artificial compartmentalization of the change process, as experienced by potential adopters. Most individuals reported feeling isolated from the other organizations involved throughout the process. In fact, this contributed to the focus of the factor groups, as individuals struggled to make sense of the implementation effort as a whole, while seeing themselves as cut off from all but the adjacent parts. These categories tended to correspond to the phases of the Systems Approach to Training (SAT) model. Analysis describes participant views on the effectiveness of the front-end analysis. Comments suggested that instructors and training division administrators interpreted this as job and task analysis, and were concerned that no one ever took the time to look at what we do down here and figure out how BMMT could support it. Senior-level command and staff, on the other hand, talked about needs assessment as described by Kaufman (1972): how does the status quo differ from the desired end-state, and what must the BMMT do to move us from here to there and felt that the trainers obvious efficiency at doing so meant the process had been successful. Design refers to participant understanding of the process used to generate the requirements for the system. Development relates to their perceptions concerning creation of the courseware. Implementation describes their feelings about the adequacy of guidance they received or ideas they were allowed to contribute as training with the system began. Finally, departing from the SAT phase factors, instruction of key personnel relates to participant assessments of the process used to familiarize them with its operation, and coordination describes their perceptions of how it all was (or was not) tied together.

Critical Issues and Recommendations

A final round of analysis focused on translating the factors identified by participants into critical issues that administrators, instructional technologists, and change agents could have focused on during the planning stages of the trainer to smooth its implementation. Many factors were eliminated at this time, reflecting differences between the participant perspective and that of the planner. This is not a judgment of validity; it is the product of an audience analysis. One senior administrator put it this way: Don't waste my time telling me what I already know; don't waste my time telling me what I can't change; don't waste my time telling me what doesn't matter This guidance defines a critical issues by exclusion. Some factors eliminated may be considered common sense (e.g., the effectiveness of the new system, by itself or relative to the old system); others are outside the organizations control (e.g., the capability, motivations, or attitude of the contractors). Many more, while they appeared in several sources, were neither pervasive throughout the data nor particularly critical to those who mentioned them. The four issues discussed here are those that represent central themes throughout the data, could have been implemented by planners and administrators in the organization, and would probably have promoted acceptance at the least cost to resources or effort (based on participant comments).

Coordination

This issue is grounded in the leader factor involvement and the bureaucracy factor coordination. Taken together, these factors describe a participant's perception of the role played by the organization's leadership in planning and managing the change process, and in keeping their subordinates informed as that process progressed. Participants especially those at lower echelons saw those in key leadership positions as uninvolved and uncommunicative. Planners and administrators were generally described as lacking knowledge of project specifics, or of technical background. Participants seldom heard anything about what was happening outside their level of their organization. This contributed to a common perception that no one was at the wheel and that other organizations either were not working much at all or were working at cross purposes. For their part, planners and administrators interviewed were clearly taking active roles in the project, and took a certain amount of pride in their grasp of its complexities. In fact, their comments often reflected a belief that the concerns of those at lower echelons stemmed from lack of exposure to the big picture

This is clearly a communications issue. The structure of this type of organization discourages information flow between other-than-adjacent echelons. Unfortunately, while it is a necessary part of military order and discipline, its strict interpretation does promote the sort of perception discussed above and restricts the ability of the organization to bring its collective experience to bear. To optimize both these criteria, the organization's leadership might sponsor some form of structured information flow outside conventional channels. One participant suggested a project newsletter, published by the project's lead organization and actively soliciting contributions from all levels of all organizations involved. This low cost alternative would provide a quick and convenient forum for participants to share ideas and keep each other current on the activities of their particular section. It would offer the dual benefit of increased goodwill and pooling of expertise on all phases of development.

Empowerment

This second issue is grounded in the bureaucracy factors analysis, design, and implementation. The intended users of a new trainer are primarily personnel from the academic department for which it is intended. Unfortunately, the findings showed that actual (future) users of the trainer were almost never consulted or involved in requirements definition. Comments from those who drew up the specifications for them often showed this to result from their perceptions that they knew what the users' requirements would be (often because they had once held the users' roles). Whether this assumption was valid or not, it fostered the impression that those in charge did not place much value on what the trainer's future users thought or wanted. Thus, in a worst case scenario, a system could be designed based on inaccurate perceptions of user needs and the users could know this and resent the system (and its proponents) for it. This in turn would encourage users to magnify the system's failures, and to blame them on their lack of involvement in defining the requirements in the first place.

To prevent this, planners and administrators should ensure the active representation of actual (future) users throughout the implementation process. This is most critical for instructors, who will have the most day-to-day contact with the system over an extended period (and thus the most impact on its success or failure). Again, this does not need to be incompatible with a structured environment. A training division administrator can be asked to task one of his instructors as the project team representative. The findings showed, however, that this person must continue to be primarily an instructor. Otherwise, his understanding of instructor priorities may become dated, and he will cease to be seen as a peer, becoming instead a project team stoolie. Similarly, such an individual must confer frequently with his fellows, to ensure that he is, in fact, representing them and not like the former user in the preceding paragraph merely assuming he understands them. Administrative and maintenance personnel who will personally use the system may be represented in the same manner. Student representation may generally be limited to observations or interviews during the front-end analysis, and conventional testing for usability and instructional effectiveness.

Competence

This issue is grounded in the participant factor competence, the external organization factor capability, and the leader factor qualifications. The importance of this issue is probably best known in relation to subject-matter (or other contextual) expertise. This is due to the prevalence of external contractors as development agencies for the type of system discussed here. While contractor personnel are usually competent developers, they generally lack the same familiarity with the subject matter being taught and the context in which it will be applied that is associated with internal personnel. However, it can be equally crippling when the perceived deficiency in competence relates to the development process itself. Likewise, if the project team is seen as lacking the authority (a sort of capability) to enact its decisions, no amount of subject-matter or development expertise will compensate for this. While each is necessary, neither subject-matter experts, nor instructional developers, nor skilled leaders are sufficient without the others to produce an effective system.

Consequently, planners and administrators should ensure that all required skills are represented when a project team is formed. That participants perceive this to be the case is at least as important. The findings offer an example where the military courseware developers possess roughly the same mix of development skills and experience as would be allocated to a project of comparable size by a contractor. However, since they did not initially possess this experience, they were written off as unqualified by many other participants. Thus, planners and administrators should attempt to select project team members whose expertise in their area is respected by other participants especially the system's intended users.

Personal Benefit

This final issue is grounded in the system factors equality and net gain and, to a lesser extent, the bureaucracy factor instruction of key personnel It has two major components. The first asks, How will use of the new system affect how well or how easily I can do my job The second asks How will use of the new system affect the nature or status of my job Comments from participants at all levels suggested that the BMMT"s implementation effort was aided by both aspects. The trainer was seen as offering substantial improvements in efficiency and effectiveness of job performance, and most participants reported some level of personal benefit associated with these gains.

Planners and administrators should understand that this may not always be the case. The BMMT replaced a similar, computer-based system that nearly all participants felt needed replacing. User roles were not substantively redefined, nor did users feel personally threatened by the new system. Systems introduced into classrooms previously dominated by lecture/conference instruction and practical exercises may leave users unsure of how they should interact with the new trainer, and threatened by its intrusion into a familiar environment with comfortable patterns of control. This can be aggravated by a change agent who stresses the strengths of a new trainer relative to conventional instruction, and is thus perceived as presenting it as a more efficient alternative.

This can create a false dichotomy between traditional and computer-based instruction. In reality, neither is a philosophy to be accepted or rejected. Both are tools for an instructor which, like any other tools, are appropriate for some tasks and inappropriate for others and both may be used together. For example, complex, conceptual topics may require the adaptive skills of a human instructor and be best suited to a lecture/conference mode while basic declarative knowledge, or psychomotor or procedural skills may require extensive, self-paced drill-and-practice and be best suited to computer-assisted delivery. Furthermore, the conceptual topic mentioned above may have to be integrated into a sequential procedure, suggesting a lecture/conference followed by a computer-assisted practical exercise. Decision-makers should emphasize this toolbox orientation, whether they are integrating a training device into an existing course or designing a new course with device-based support. A strategy that recognizes the instructor as the central component of all resident instruction is likely to meet with much more enthusiasm than one that proposes a device or system as the new center of attention. Technological support should instead be introduced as a means of relieving the instructor of tedious, repetitive administrative chores that a computer can perform more efficiently thereby freeing him to address the real business of teaching. An important part of this approach must also be provision of transition training, to provide instructors with tips and techniques for using the system to their greatest advantage, as these techniques are frequently quite different from those used in unassisted platform instruction.

DISCUSSION

Beginning with its central question, this study's findings can be summarized as follows: triangulation from the three data sources (interviews, historical documents, and participant-observation) produced a set of robust factors offering a credible explanation for participants adoption/rejection decisions. As expected, the BMMT as a successful system provided a wealth of positive comments that reflected a solid implementation strategy. More surprisingly, it also offered many lessons learned, pointing out factors that were not addressed to the satisfaction of most potential adopters.

Taken together, these positive and negative impressions represent the importance of each factor to participants . . . and thus the value of attention paid to that factor as a force multiplier for increasing the systems chances of acceptance. Considered separately, the vector sum of these impressions represents the degree to which planners and administrators already understand and attend to each factor. (A strong, positive vector sum shows the factor is under control; a strong negative suggests it is not, with a range of possibilities between). By applying these criteria, together with an assessment of the organization's leverage on each factor, this study was able to derive a set of critical issues which deserve additional attention. (This approach may be useful even in situations where these particular factors are less prevalent.)

Moving on to the first related question, the initial hypothesis concerning the effect of a participant's role relative to the trainer was confirmed by the findings. Its effect, however, was primarily one of perspective on each factor, rather than determining the factors themselves. Furthermore, based on analysis of the types of comments made by each participant, some migration occurred from Garland's categories. As a result, several participants finished the study in a category other than that for which they were selected. Redesignation of the categories according to their new membership resulted in the following perspectives: management, administrative staff, instructors, and students.

Concluding with the final question, comparison with previous studies showed widespread congruence. Differences that arose reflected viewpoint more than substance, and illustrated key effects of the military setting. For example, the traditional category of training effectiveness was frequently viewed as a negative factor because students who are also soldiers are expected to succeed in spite of the worst the environment can throw at them. Table 1 summarizes the correspondence between factors identified in this study and three prominent frameworks based on research in other settings. (Each X represents one corresponding factor.)

TABLE 1 Support for Factors from Research in Other Settings

Identified Factor	Rogers (1983)	Ely (1990)	Zaltman & Duncan (1977)
Participant Type			XXX
Participant Background	X	X	XX
Competence		X	X
Views of Change	X	XXX	XXXXX
Quality	XXX		
Net Gain	XX	XXX	XXXXXX
LessonsLearned	X		
Capability		X	X
Motivation			XXXX
Attitude			XXX
Continuity		XX	
Qualifications		X	XX
Involvement		XXXXX	XX
Analysis		X	X
Design		X	X
Development		X	X
Implementation		X	X
Instruction of Key Personnel	X	XX	XX
Coordination			XX

The scientific impacts of this study follow from this comparison. Despite the environmental differences associated with a military setting, the factors that the study identified corroborated those of its civilian/educational predecessors. This supports the possibility of a diffusion paradigm that is, at some level, applicable across all settings. At the same time, the different viewpoint of the results adds richness to the research base through examples of setting-induced variance.

Limitations of the Study

The most critical limitation of this study results from its status as a single-site case study. Of all qualitative techniques, this type of study offers the least generalizability due to its focus on a particular situation. Other threats to external validity (generalizing power) include its use of a military site, with the associated centralized, highly cohesive structure. While the support drawn from previous research in other settings offers some assurance that similar factors may be encountered elsewhere, the findings reported will be of primary use only to suggest issues for consideration, or frameworks for future inquiry.

It should also be remembered that this study's objectives were restricted by the research questions. Factors were identified and used to generate issues for consideration, and these issues were examined for the effect of participants' roles relative to the system (and compared with frameworks from research in other settings). Beyond this, exploration of interrelationships between factors, or statistical investigation of correlations between factors and demographic characteristics, are deferred to future studies.

Implications for Future Research

While this was intended primarily as an exploratory study, its findings suggest several implications for future diffusion research. Most notably, it derived a set of factors without placing a priori restrictions on the type of factor being sought. In contrast, while several well-validated frameworks exist, most previous research in this area focuses on part of the diffusion problem. Rogers identifies innovation characteristics facilitating adoption; Ely does the same for environmental conditions; Zaltman & Duncan look chiefly at factors hindering adoption. As the field was being defined, this approach made a great deal of sense, amounting to a divide and conquer strategy. Now, perhaps, a more appropriate role for future inquiry is the integration of these perspectives: looking at the diffusion problem as a whole (the innovation and its environment) from whatever mix of perspectives (acceptance and resistance) offers the most rigorous explanation of the observed phenomena.

Another implication is embedded in the method employed to derive critical issues from the identified factors. The technique used is new, as far as the author is aware. It has the advantages of being simple, and allowing an objective means of comparing factors to identify the most cost-effective opportunities for intervention. However, while this procedure may be intuitively appealing, and appears to have produced reasonable results in this circumstance, it has not been validated outside this study. Future investigations of this sort may wish to learn if it has wider application.

Finally, the findings of this study offer an in-depth look at the factors affecting the adoption/rejection decision for the full range of participants in the implementation of a particular training device in a particular Army discipline. While this evidence is probably adequate to suggest attention to the identified factors in any future implementation, it is not sufficient to conclude that there are no other factors of equal importance to other systems, or in other disciplines or environments. Ideally, further expansions of scope should be conducted until no new issues are revealed. Such augmentation would have the additional benefit of clarifying the factors already discovered, offering insight into issues such as circumstances causing a particular factor to assume prominence in a particular implementation, interrelationships between factors, or correlations between factors and demographic characteristics. The result could be a user's guide for implementing technological support for any training in any environment.

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Title:

Reflective Self-Regulation as a Facilitative Factor in Learning from Case-Based Instruction

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Abstract

This exploratory study integrated information from quantitative and qualitative data sources to highlight how different students responded to, and learned from, case-based instruction. Fifty-eight first-year veterinary students, enrolled in a biochemistry laboratory course which utilized case studies as one of the primary methods of instruction, participated in the study. Quantitative data, gathered from students' pre-course performances on two learning inventories, were used to classify students according to their initial levels of self-regulation. By identifying those students who fell at both ends of the inventory scales, comparisons could be made between different types of learners. Nine students, representing high and low self-regulators, were interviewed at three different times during the semester to explore initial and changing responses to case-based instruction. Using a constant comparative method of anaylsis, an analytical framework was developed which identified critical factors which seemed to facilitate, or limit, students' ability to learn from this method.

Introduction

Case-based instruction has long been established as an effective teaching method in schools of law and business and is increasingly being used in other professional fields as well, including: medicine, political science, journalism (Knirk, 1991), teacher education (Kagan, 1993; J. Shulman, 1992), architecture (Schon, 1983, 1987), educational psychology and measurement (Silverman, Welty, & Lyon, 1992), and instructional design (Romiszowski, Mulder, & Pieter, 1990). Although case-based instruction is not new, J. Shulman (1992) states that a body of theory and research has yet to be developed which explains why "they are so unusually effective" (p. xv). It is not that the value of case studies has not been debated; indeed, there is a large literature base which discusses the perceived benefits and challenges of the case method of instruction. However, when Masoner (1988) recently reviewed any literature that could be construed as an evaluation of case methods, he found mostly "anecdotal evidence, unpublished studies, and a small assortment of unrelated and non-cumulative published studies" (summarized in Kleinfeld, 1991, p. 3). Furthermore, the little research that has been done in this area has mainly been concerned with the relative impact of case-based instruction on the class as a whole, as compared to other, more traditional methods (lecture, expository texts), and has been almost entirely quantitative in nature (Beckman, 1972; Masoner, 1988; L. Shulman, 1992).

To date, very little work has been done which carefully examines how individual learners respond to, and/or learn from, case-based methods of instruction (Knirk, 1991). The possibility that individual learning needs may not "match up" with the specific characteristics and demands of this method seems to be downplayed, if not completely ignored. The general implication in the literature is that cases are more motivating for *all* learners, that they promote better transfer in *all* learners, and that they can transform *all* learners into better problem solvers and critical thinkers (e.g., L. Shulman, 1992). Only a few educators have suggested that case-based instruction does not "work" for all learners (Cossom, 1991; Welty, Silverman, Lyons, 1990). Cossom (1991, p. 151) states that, "clearly (case-based instruction) is not a teaching/learning method that appeals to all students, nor is it one that draws neutral responses." He cites Daloz in postulating that "students at different levels of moral and cognitive development will have varying degrees of comfort with ambiguity, lack of a "right" response, and multiplicity of views" (p. 150), qualities inherent in a case-based approach.

It is fairly well-acknowledged that students approach learning in a wide variety of ways; they come to school with different amounts and kinds of background knowledge; they have reached different levels of cognitive development; they hold varying degrees of motivation for the content to be learned (Paris & Byrnes, 1989). We cannot begin to assume that, left to their own devices, all students will respond similarly to, or benefit equally from, any single instructional method, including case-based instruction. It would be beneficial to understand *how* students learn from cases; to identify specific learner characteristics and particular learning strategies that facilitate, or limit, learning from this approach.

The three main purposes of this study were:

1) to examine students' initial responses toward, and strategies for learning from, case-based instruction
2) to describe how those responses and strategies changed over the course of a semester in which case-based instruction was utilized
3) to compare the initial and changing responses and strategies of different types of learners as they progressed through a case-based course

This study is based on the assumption that responses toward, and subsequent performance in, a case-based course depends highly on one's level of self-regulation—defined here as the ability (and propensity) to implement, monitor, and evaluate various learning strategies for the express purpose of facilitating knowledge growth. Although highly self-regulated learners may have no prior knowledge of the specific content being taught (e.g., biochemistry), or previous experience with the specific instructional methods being used (e.g., case studies), their ability to activate, alter, and sustain appropriate learning practices predicts that they would achieve academic success in familiar, as well as new, learning contexts (Zimmerman, 1990). By observing how highly self-regulated students approach case-based instruction, specific facilitating attributes, attitudes, and approaches might be identified. Conversely, by observing the manner in which low self-regulators approach case studies, we might pinpoint potential debilitating responses and/or ineffective strategies which limit learning. Ultimately, it is hoped that we might identify *enabling* instructional conditions and strategies which enhance the performance of all kinds of learners in a case-based learning environment. It is hoped that information gained from less regulated students will indicate not just the limiting factors which might be minimized, but also the supportive factors which might be maximized in subsequent learning situations. By examining how different students' responses and strategies promote, or limit, their ability to learn from cases, instructional methods for facilitating and enhancing case-based learning, for all students, might be identified.

The assumption that self-regulation skills are a facilitative factor in learning from any instructional method (including case-based instruction) is well-grounded in the literature (e.g., Lindner & Harris, 1993; Weinstein, 1988; Zimmerman, 1990). According to the definition above, students with high levels of self-regulation possess the attributes and skills that would be likely to enhance performance in a case-based course. Self-regulated students are aware of important learning variables and possess the necessary knowledge (of self, of learning strategies, and of task requirements) to take control of their own learning environments (Palincsar & Brown, 1989). Furthermore, they are motivated to do so.

However, the assumption that self-regulation skills can be *enhanced* through involvement in case-based instruction is also suggested by research. Although students with low levels of self-regulation may not have the skills or strategies needed to perform well *initially* in this environment, specific pedagogical features of case-based instruction are thought to facilitate the development of these skills. For example, in a review of programs designed to teach higher order cognitive skills, Resnick noted that the most successful programs were those which employed "cooperative problem solving and meaning-construction activities" (summarized in Resnick & Klopfer, 1989, p. 8). Such small and large group problem solving activities are *central* to the case approach; the effective case teacher operates not as a knowledge-dispensor but as a model, coach, and facilitator. Furthermore, case-based discussions provide opportunities for each student to serve as a monitor and reflector for the others, thus facilitating the growth of metacognitive monitoring and reflection. By involving students in the "disciplined and productive mental work" (p. 10) of case-based instruction, it is believed that students can learn how to learn.

Based on the assumptions stated above, it is expected that the following phenomena would be observed in a case-based learning environment:

1. Initially, high self-regulated students would be more comfortable with the case approach and would utilize more effective strategies to analyze cases than low self-regulators.
2. Low self-regulated students' performance would improve over time, with sustained involvement and continued practice.

How can we gauge the progress that learners make in regards to becoming self-regulated? Is self-regulation a characteristic that students either have or don't have? Or is self-regulation a skill, likened, perhaps, to expertise, that evolves slowly over time? If it *is* developmental, how can we assess whether students are, indeed, becoming more self-regulated in their learning? Unlike many learning theorists today, Ridley (1990) believes that *all* behavior is, to some degree, self-regulated. Thus Ridley proposes a self-regulation continuum which ranges from "unreflectively automatic self-regulated" on the low end to "reflectively intentional self-regulated" on the high end. This continuum provides a model for describing how learners with different levels of self-regulation might respond to new, and potentially uncomfortable, academic situations. Ridley's continuum also offers a viable means for gauging changes in learners' levels of self-regulation. For example, if students become less automatic and more thoughtful in their approach to cases (i.e., they make some movement along the continuum), this might be a reasonable indicator that they are making progress in the development of "reflectively intentional" self-regulation habits.

Theoretical Framework

This exploratory study was designed to seek "interpretive outcomes" (Peshkin, 1993), that is, insights that might begin to clarify the complex processes involved in students' learning from case-based instruction. To this end, both qualitative and quantitative methods were used. Quantitative methods, nested within a larger interpretive, or qualitative, framework, were employed primarily as a means to classify students according to their initial levels of self-regulation. An overarching interpretive framework (e.g., Eisner, 1991; Erickson, 1986) guided the search for patterns of responses to case-based instruction. According to Dillon (1989), qualitative research has been used "as a means of answering previously unanswered questions concerning how . . students learn' (p. 227). In this study, interpretive inquiry offered a realistic means for more clearly defining how different students respond to, and learn from, case-based instruction.

Students' perceptions of learning in a case-based course were examined with the express purpose of describing case-based instruction from the point of view of the students. Phenomenology provided a useful theoretical framework for exploring students' responses to, and learning from, this type of instruction. Kuh (1993) states that "it is impossible to understand the human experience without taking into account the complicated, mutually shaping events, actions, and motivations of the individual . . . under study" (p. 278). This particular theoretical framework enables a researcher to tap into individual perceptions regarding learning from cases using the techniques of questioning, focusing, reflecting, and intuiting (Van Manen, 1990). In this way, the structures of meaning embedded in students' experiences of case-based instruction could be explored.

Methods

Description of the site, course, and participants

The site. A professional school of veterinary medicine, located at a large midwestern university, is one of only 27, nationwide, which grants the degree of Doctor of Veterinary Medicine (DVM). The four year program typically limits enrollment to 60 students per class. The school catalog states that "each prospective student is required to complete a prescribed preprofessional curriculum for two or more collegiate years before admission to the school." Other criteria for admission (e.g., academic performance, maturity, and motivation), once considered to be quite stringent, have been relaxed in recent years to boost declining enrollments, resulting in a more heterogeneous student population.

The course. A required freshman course, "Systemic Physiology II (Biochemistry)," provided the context for this study. The course (VPH 442) is described in the syllabus as "an introduction to biomedical principles and their application to veterinary medicine." The lab portion of the course focused on the application of principles learned in lecture to hypothetical paper-patients who mimicked real-life disorders. Two sections of the lab were offered by the same instructor during the spring semester in which the study took place. Although students were specifically assigned to one of the two labs, they typically attended the lab which was most convenient for them during any specific week. Therefore, the total number of students in any one lab fluctuated between 15 and 45 students.

VPH 442 was designed so that students received approximately two hours of both lab and lecture each week throughout the 16 week semester. Biochemical case studies were used as one of the primary methods of instruction and as an evaluation tool in both lab sections of the course. Case study presentations followed a fairly typical pattern: students were presented with a limited description of an animal in distress. Some of the animal's symptoms were described, accompanied by appropriate illustrations and diagrams, and then students were asked to analyze the patient's condition and to make tentative diagnoses and recommendations for action. Students worked in groups and were encouraged to ask questions, to check available resources, and to consult with the instructor before arriving at preliminary conclusions. All case investigations concluded with a large group discussion in which student recommendations were considered in light of supporting (or negating) lab and clinical data.

Participants. Students: Sixty-one first-year veterinarian students were enrolled in the biochemistry lab course during the time of the study. Data sets from three students were incomplete, leaving a total of 58 students who completed the study. Of these 58 participants, 66% were female (n = 38). Ages ranged from 20 to 40 years ($\underline{M}$ = 24.22, $\underline{SD}$ = 3.99). Although the majority of students ($\underline{n}$ = 36) had completed a bachelor of science degree prior to entering this program, their levels of education ranged from two years of post-secondary education ($\underline{n}$ = 15) to a masters degree. Most students in this program had a background in either biological science or agriculture, although other fields were also represented. In addition, several students had previous job experience in fields as diverse as accounting, management, and dentistry.

The teacher: Marie McDonnell (not her real name) is a 34-year-old practicing veterinarian, as well as a graduate student in the School of Education. Besides working 1/2 time at a small animal clinic at the time of the study, Marie also had a graduate teaching assistantship which required her to spend approximately 20 hrs/week designing and teaching the biochemistry lab. Six of the other 8 core teachers in the freshmen curriculum were also DVMs, but only 2 had ever practiced. This put Marie in a unique position within the school; although she was technically a student, she had more practical experience than most of the professors. Marie had been teaching this particular lab for two years, gradually increasing her use of case studies until they had come to represent the primary instructional method. According to previous course evaluations, students liked the case approach.

Data Sources

Information from quantitative and qualitative data sources was integrated to highlight how different students responded to, and learned from, case-based instruction. Quantitative data were gathered from students' performances on two individual learning inventories administered at the beginning of the semester, as well as from GPAs and final course grades. These data sources provided the means to classify students so as to compare the responses of different types of learners to case-based instruction. Qualitative data were gathered from periodic student interviews and three written case analyses with additional evidence provided from classroom observations, teacher handouts, and course evaluation forms. These data sources were instrumental in *understanding* the responses of these different learners as they participated in a case-based biochemistry laboratory. In addition, all data gathered at the beginning, middle, and end of the semester were compared to identify how students' responses and strategies changed over the course of the semester.

Measurement Tools

Two self-report learning inventories, based in the self-regulation literature (MSLQ and SRLI), were used to assess the strategies students used to facilitate their learning. These strategies included: cognitive (rehearsal, organization, and elaboration), metacognitive (monitoring, evaluating, and reflecting over one's learning), motivational (interest, value, and confidence for learning specific course content), contextual (awareness of task requirements), and environmental control (time and resource management).

The Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991) is a self-report questionnaire designed to assess college students' motivational beliefs and their use of different learning strategies for a specific college course. The 81 item, Likert-type survey is divided into 15 subscales that ask students to respond to items regarding motivation, cognitive and metacognitive strategy use, and management of outside resources, using a 7 point response format (1 = not at all true of me; 7 = very true of me). The motivation section consists of six subscales (31 items) that assess students' goals and value beliefs for a course, beliefs about their skill to succeed, and anxiety about tests. The cognitive and metacognitive strategy section includes five subscales (31 items) assessing student use of cognitive and metacognitive strategies such as rehearsal, elaboration, and organization. The resource management section includes four subscales (19 items) concerning management of outside resources.

The second measurement tool, the Self-Regulated Learning Inventory, (SRLI) (Lindner, & Harris, 1992) is comprised of 75 self-report items categorized into five subscales including: Metacognition, Learning Strategies, Motivation, Contextual Sensitivity, and Environment Control. The items are presented randomly on a single test using a 5 point Likert format.

Data collection and analyses

Quantitative. All students were administered the two self-report learning inventories during the first week of the 1994 spring semester. The results of these inventories were used to classify students into one of three categories representing each student's level of self-regulatory skills: high, medium, or low. Because it is difficult to capture the dynamics of self-regulated learning with a self-report instrument (P. Pintrich, informal presentation, November 16, 1993) it was considered advantageous to use two separate measures of self-regulated learning with each serving as a check on the other. Students who scored relatively high (or low) on both scales might be more reliably classified as high (or low) self-regulators. In an effort to achieve a more observable contrast between different types of students, those who fell within the "medium" category were not evaluated further in this study, although they participated in the same class activities and completed the same course assignments as the other students.

Qualitative. In order to gain an understanding of students' perceptions of their learning experiences in a case-based course, it was essential to utilize methods that tapped those perceptions. Thus, *phenomenological interviews* (Kuh, 1993, p. 278) "whereby the inquirer gains access to the meanings individuals attach to their own experience(s) using a semi-structured interview guide" constituted one of two primary data sources. In order to hear individual, as well as collective voices, four students were selected, purposively (Patton, 1990), from both the high and the low self-regulated groups to be interviewed at three different times during the semester. Purposive sampling helped to ensure that representative perceptions would be obtained regarding learning from case-based instruction. One additional student (Roslyn), who fell within the "middle" range of self-regulators, was also included in the interview sample as it was expected that her perspective, as an "older" student with many years of clinical experience, may be particularly informative. Although Roslyn achieved the 5th highest score on the MSLQ, her score was average on the SRLI. For all subsequent analyses, this student's data were combined with that of the high self-regulators.

Phenomenological interviews were used to assess students' responses toward the case method as well as their strategies for learning from this type of instruction. Interviews were semi-structured, beginning with open ended statements ("Tell me about Biochemistry Lab."), and concluding with a few direct questions ("What do you do when you are given a case study to analyze?"; "How do you feel when you are asked to analyze a case study?"). Based on the work of Pintrich and his colleagues (e.g., Garcia & Pintrich, 1994; Pintrich et al., 1991) which suggests that students' performances are differentially affected by the motivational subcomponents of interest/enjoyment ("How *interesting* is this instruction to you?"; "How do you *like* this type of instruction?"), value/importance ("How *valuable* is this instruction in terms of your future work?"), and efficacy ("How *confident* do you feel learning from this type of instruction?"), additional questions addressed these components.

Students' written case analyses constituted the second primary data source. During the 3rd, 8th, and 16th weeks of the semester, all students were given a written case study and asked to list: 1) the potential problems or issues presented in the case, 2) prioritized differential diagnoses, and 3) possible ways of handling the case. Besides a simple count of the number of problems and differential diagnoses listed, the content of students' written responses were examined to identify strategies employed by students' in their case analyses. The first level of coding identified the number and variety of cognitive strategies (e.g., underlining, highlighting, mnemonics, etc.) used by each student. Students' analyses were then searched for any indications of the use of metacognitive strategies, particularly those indicative of reflecting on, monitoring, and evaluating one's own work (e.g., self-questioning, using tentative words, writing notes to oneself, etc.).

Over the course of the semester, 27 interviews were conducted and 63 written case analyses were examined (3 analyses completed by each of the 10 high and 11 low classified students). All of the interview and case responses were read and coded, using a constant comparative method of analysis (Glaser & Strauss, 1967). Reliability was established by having an independent reviewer classify a random sample (20%) of interview statements using the coding criteria described in the next section. Judgments of students' analyses, in terms of accuracy and thoroughness, were made by the instructor.

By reading and rereading interview transcriptions and case analyses and then comparing findings across data sources, across time, and across students, an analysis framework was gradually developed and refined. Beginning with transcriptions of the first set of interviews, a search for significant meanings was undertaken. As students' first case analyses were examined, key linkages were sought to connect similar, emerging themes. In addition, attention was paid to negative cases which suggested opposing explanations. Subsequent readings of initial interviews and case analyses, combined with readings of additional interviews and analyses, facilitated the gradual development of an interpretive model of students' responses to, and strategies for learning from, case-based instruction. As similar patterns began to emerge from each main data source, secondary data sources were examined (e.g., field notes from classroom observations, teacher case documents, and student course evaluations) in an effort to cross-validate assertions Finally, an analytic framework was created which integrated evidence from all sources.

Results and Discussion

This section of the paper discusses results from both quantitative and qualitative data sources with the main focus being on results related to the defined purposes of this study. After addressing the first two purposes regarding initial and changing responses toward, and strategies for learning from, case-based instruction, an analysis framework is presented as a means of interpreting these results. Due to space limitations, an abbreviated version of some results is provided; a more detailed explanation is available from the first author.

Quantitative

Initial analysis of students' scores on the two learning inventories identified 9 high and 11 low self-regulators. Selection criterion required students' scores on both scales to be greater than .5 standard deviations above, or below, the mean. In addition, students chosen to be interviewed were those who had scores on the metacognitive and self-regulation subscales (Self-Regulation Subscale-MSLQ; Metacognitive

Subscale-SRLI) that were greater than, or equal to, .5 standard deviations above, or below, the class mean. As mentioned previously, an additional student from the "middle" group was included with the 9 high self-regulators for subsequent analyses.

Selection criterion resulted in the following sample of high and low students: All high students were female; 4 of the 11 low students were female. The average age of the high students was 25.2 years compared to an average age of 23.6 years for the low students. Average GPAs were 3.186 for the high group; 3.107 for the low group. Table 1 presents a compilation of specific demographic information for students in each of the high and low groups, as well as their scores on the two learning inventories. Group averages for the high and low students are also included. Although all names are pseudonyms, the demographic information is accurate. Results from additional descriptive and correlational analyses of the survey data are not reported here, however, descriptive analyses based on student interview or case-analyses data are integrated within the qualitative results.

Table 1
Demographic Information for Students Classified as High and Low Self-Regulators

Group (H; L)	Student	Sex	Age	MSLQ Score	SRLI Score	Yrs of school (post HS)	# of Prior Courses	GPA	Related Experience
H*	Marci	F	22	486	333	3	1	4.00	BS-Biology; worked 4 yrs in small animal clinic
H*	Winnie	F	26	495	317	5	0	2.52	BS-Biology; Dressage instructor
H*	Sharon	F	24	478	304	4	2	2.94	BS-Animal Science; 5 yrs with small animal vet; 2 yrs equine emer. referral service
H	Deidra	F	23	446	287	4	1	3.08	No experience listed
H*	Mallry	F	23	450	318	4	3	3.61	Pre-Vet; worked in Animal Control
H	Tami	F	27	451	334	5	1	3.16	BS-Zoology
H	Lucy	F	27	452	278	4	1	3.43	BS-Industrial Mngmnt; Pre-Vet
H	Cyndy	F	27	443	293	9	1	3.46	MS-Zoology
H	Linda	F	21	462	289	2	2	2.86	Pre-Vet; Equestrian Team
H**	Roslyn	F	32	467	272	4	1	2.80	13 yrs in Vet Clinic; 3.5 yrs in small animal ICU
H-Ave		*All F*	*25*	*463*	*302.5*	*4.4*	*1.3*	*3.18*	
L	Jon	M	23	369	241	4	2	2.80	BS-Animal Science
L*	Ronald	M	23	340	227	4	0	3.06	BS-Biology; Raises snakes
L	Mick	M	25	395	228	6	2	3.63	BS-Accounting
L	Ira	F	25	360	196	2	1	3.17	AS-Science
L	Candy	F	26	389	230	4	2	3.18	BS-Biology
L*	Deena	F	22	367	233	4	2	2.71	BS-Animal Bioscience; Pre-Vet
L	Carl	M	22	388	247	4	1	3.08	BS-Biology; Pre-Vet
L*	Chrissy	F	22	396	239	4	1	3.53	BS-Eng/Chem Double Major
L	Matt	M	25	382	229	3	1	3.26	Biology Club
L*	George	M	21	379	215	2	0	2.60	Pre-Vet; Swine, cattle experience
L	Marvin	M	26	363	246	4	2	3.16	BS-Medical Technology
L-Ave		*4 F*	*24*	*375.3*	*230.1*	*3.72*	*1.27*	*3.11*	

* Students who were interviewed

** Student who scored at high/med level; included with high students for all analyses

MSLQ M = 415.25, SD = 35.42; SRLI M = 264.55, SD = 29.51

Qualitative—Responses toward case-based instruction

Initial and changing responses toward case-based instruction were tapped by asking probing questions during three successive interviews which were specifically related to: 1) students' interest in using cases, 2) the perceived value of using cases, and 3) students' confidence for learning from this method. Students' initial and subsequent responses to these questions are summarized below, along with a comparison between responses made by high and low students, when possible.

Initial responses. Interest: In describing their initial reactions to the use of cases in the biochemistry lab, almost all students interviewed (both high and low) indicated that they thought that cases would make the class more interesting and more fun. Some likened it to a game, or a puzzle, mentioning the challenging, enjoyable aspects of cases. Others described how their motivation was positively affected and how it had spilled over into other coursework. Most students simply indicated that case-based instruction was more interesting than their other classes and provided a nice change of pace. Only Deena qualified her comments by stating, "They're good, but only to a certain degree."

Value: All 9 students claimed that cases were "real-life" and had some practical benefits. Although 3 of the 4 low students noted that cases would help them remember more, they judged that this would not affect other coursework or career goals. This stands in contrast to the 5 high students who all mentioned that the case method was very valuable to their future careers, as well as to other coursework. Not only did these high students value the practicality of case-based instruction, but they also noted some global benefits such as learning the "problem-solving" approach and integrating their knowledge.

Confidence: All of the students expressed some concern regarding their ability, at this point in their careers, to accurately diagnose the cases they were given ("Well, I have no idea what it could possibly be because I only know 2 diseases and that's all!"). They used words such as: scared, frustrated, nervous, and intimidated. However, all but one low student mentioned that this lack of knowledge would result in increased effort ("I probably put more effort into understanding what we learn in this class because . . . I know that it will definitely be useful."). Additionally, everyone but Roslyn (who had a lot of previous experience in a vet clinic) expressed feelings of discouragement due to a lack of knowledge that they judged was essential to "solve" the cases.

Changing responses Interest: Even though some low students were "burned out" by the end of the semester, most of their frustration seemed to be related to outside sources (other tests, deadlines, etc.), rather than to the course itself. Low students seemed to be especially sensitive to these other factors. Course evaluations support the conclusion that most students still enjoyed the course at the end of the semester. On a scale from 1-10 the average course rating was 8.9. Unsolicited comments mentioned enjoying the case-study approach and having fun in the class: "Truly enjoyed labs. They made my others relevant." ; "I greatly enjoyed the lab!!! It was the only class in our freshman curriculum which makes you think logically about cases you will see as a clinician."

Value: As the semester went on, there seemed to be a shift in emphasis regarding which aspect of the case approach was valued most. Low students, particularly, moved from a focus on practical benefits (change of pace, ability to remember more facts) to more overarching benefits (application of knowledge, learning the problem-solving approach). The process, rather than the product, began to take on increased value.

Confidence: As students became more comfortable with the problem-solving approach, as their knowledge base increased, and as their experience with cases increased, they became more confident of their case analyses. However, the primary factor influencing students' confidence levels seemed to be the amount of prior knowledge and previous experience they had. "If I had a broader repertoire of possibilities, I would have felt more confident." However, some high students actually became motivated by their lack of knowledge: "It's like a kid with with a new video game!"

Students from both groups seemed to redefine success during the semester and adjusted their judgments of confidence to match. Students began to emphasize "coming close" rather than naming a specific disease that may have caused the presenting problems. If diagnoses were "in the ballpark" students judged that they had been successful ("I knew this, this, and this, but being able to list one specific problem, no, I don't know enough diseases or technical names to write anything down. But it comes close.").

By Time 3, "scared" and "nervous" feelings were no longer mentioned, yet all four low students became particularly frustrated by their lack of knowledge, by the specific case, or by the tediousness of the work. These students were more apt to complain about other responsibilities, other course requirements, and other external factors (time and length of lab) that contributed to their levels of stress.

Summary of Initial and Changing Responses. When the initial and changing responses of high and low students are compared, an interesting difference is noted. For the most part, high students started with, and maintained, a positive attitude toward the use of case studies throughout the semester. Sensitivities were noted only in response to the type of case being analyzed. In contrast, low students started with a rather narrow view of the value of cases and were less confident of their initial analysis skills. By mid-semester, however, most of these students had gained in confidence and had broadened their view of the value of case-based instruction. Yet by the end of the semester, other pressures appeared to overcome some of these students and their motivation and confidence for learning from this method decreased. It is encouraging to note, however, that two of these students (George, and to some extent, Chrissy), continued to make progress in becoming more comfortable with, and strategic in, their approach to the case method.

Qualitative—Strategies used in case-based learning

Students' initial and changing strategies for learning from cases were garnered from two sources: 1) written case analyses and 2) students' responses to interview questions regarding what they did when they were given a case. Both cognitive (e.g., underlining, using mnemonics, organizing information) and metacognitive (e.g., writing notes or parenthetical comments to oneself, asking rhetorical questions, using tentative words) strategy use were examined. Although a detailed explanation of this aspect of the study is not reported here, Table 2 outlines the different types of strategies that were used by high and low students in each of their case analyses.

Table 2
Number of Students Using Cognitive and Metacognitive Strategies on Each Case Analysis

Cognitive Strategy	**Case 1**	**Case 2**	**Case 3**
Underlines, Circles, Highlights			
High/Low	8/6	5/6	8/6
Uses Indicators			
High/Low	6/1	4/4	2/0
Organizes Information			
High/Low	0/1	6/7	2/0
Uses Mnemonics			
High/Low	3/3	3/3	2/1
Summarizes			
High/Low	0/0	1/5	1/1
Metacognitive Strategy	**Case 1**	**Case 2**	**Case 3**
Asks Rhetorical Questions			
High/Low	4/4	3/5	8/8
Writes Notes to Self			
High/Low	7/5	5/5	6/0
Uses Tentative Words			
High/Low	8/7	4/7	3/4
Looks for Links			
High/Low	7/5	5/4	3/2
Uses Evidence			
High/Low	9/10	2/3	4/5
Considers Context			
High/Low	3/1	1/1	8/7
Looks at Big Picture			
High/Low	2/2	2/0	1/0
Uses "I" Statements			
High/Low	5/5	1/1	7/4
Uses Technical Words			
High/Low	7/6	9/11	8/8
Is Complete and Thorough			
High/Low	2/0	7/3	2/4

Analysis Framework.

A search for commonalties across cases revealed two general orientations to case-based instruction, which were loosely coded as limiting and facilitative. Based on a modification of Ridley's (1990) description of a self-regulated learning continuum (from automatic to purposeful), interview statements and case-analyses strategies were identified which seemed to represent both ends of this continuum. Statements of an "automatic" nature were considered to be indicative of a limiting approach to case-based learning, whereas statements of a more "purposeful" nature were thought to represent a facilitative approach.

Limiting factors, identified from interview comments, included such things as: setting product goals for the course ("I'd like to basically keep up with the course"), using automatic or habitual strategies with very little thought ("That's how I've always done it"), holding a narrow view of what constitutes professional knowledge and expertise ("I felt nervous about doing the case and also what the teacher might think if I wrote the totally wrong thing"), excusing one's performance because of limited resources ("I wasn't given enough information"), and being highly sensitive to contextual and environmental influences ("Classes tend to run over time, and it's kinda hard to get motivated to do much of anything except go home").

Facilitating factors, identified from interview statements, consisted of: setting process goals for the course ("I'd like to learn as much as possible how to approach cases"), being aware of how one learns ("I like to be able to see something, to visualize the problem"), recognizing one's automatic responses to novel and/or difficult learning situations, and then implementing alternative strategies, if necessary, in order to be successful ("You gotta tell yourself that you're not a senior"), holding a wide view of the meaning of knowledge and expertise ("The first time I tried to get too specific instead of doing a more general approach to it"), and drawing on available personal resources in order to master a valued learning goal ("I try to think of what we'd done in other classes; things I learned before that could help me"). Besides prior knowledge and experience, personal resources also included facilitating factors such as: openness to emotional challenges, persistence at difficult tasks, and increased or sustained motivation ("You want to try because it's like playing a game to see if you can win").

Interview transcriptions were searched thoroughly for specific comments which seemed to represent either of these orientations to case-based instruction. These comments were then classified according to the components of the facilitative-limiting framework described above and depicted in Table 3 (i.e., process vs product goals; reflective vs automatic responses; wide vs narrow lens; professional vs student view; hardly or highly sensitive to contextual factors; and reference to available vs limited resources). A total of 480 comments were classified into these 6 categories. To ensure that consistency was maintained within categories, a second judge classified a random selection of comments (20%) from each category. The following reliabilities were reported for each category: Process/Product = 90%; Reflective/Automatic = 86%; Wide/Narrow Lens = 81%; Professional/Student = 92%; Contextual Sensitivity = 100%; Available/Limited Resources = 93%, for an overall interrater reliability of 90%. Disagreements were resolved, in most cases, by providing additional contextual information for specific comments or by discussing discrepancies and then making a mutual decision regarding final classification.

Table 3
Students' Approaches to Case-Based Instruction

	Facilitative	Limiting
Type of Goals	**Process** •Learn the approach •Integrate information •Gain global knowledge	**Product** •Pass the course •Get a grade •Learn the right answers
Level of Self-Awareness	**Reflective** •Plans—thinks then acts •Monitors—adjusts actions •Evaluates—approach & product	**Automatic** •First reactions •Habit •Unaware of own learning habits
Range of Lens	**Wide** •Values general diagnosis •Values shared expertise •Criteria for success self-imposed	**Narrow** •Values specific answer •Acquiesces to authority •Criteria imposed by others
Point of View	**Professional** •Open to emotional challenges •Willing to change	**Student** •Self-protection •Survival over development
Contextual Sensitivity	**Not sensitive to:** •Knowing the "answer" •Task difficulty •Environmental factors •Other pressures	**Sensitive to:** •Getting a grade •Type of case •Time of day, length of case •Other pressures
Resources	**Available** •Prior knowledge •Previous experience •Increased motivation and effort	**Limited** •Knowledge •Experience •Ability

Qualitative—Comparison of responses and strategies of different types of learners

In order to compare the initial and changing responses and strategies of different types of learners as they progressed through the course (purpose #3), student interview responses were mapped onto the framework presented in Table 3 and then compared across time and across groups. Table 4 presents a separate matrix for each of the three case analyses in which each student's case approach is defined in terms of its facilitative and limiting features. This is followed by a more general matrix in Table 5 which summarizes the information from the first three matrices. Each matrix was completed by coding students' interview comments in terms of the previously identified categories.

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Table 4

Interview Content Analysis-Time 1

Student	Classification (high vs low)	Process vs Product Goals	Reflective vs Automatic Responses	Wide vs Narrow Lens	Professional vs Student View	Contextual Sensitivity	Available vs Limited Resources
Sharon	H	Process	Balanced	NEI*	Professional	Insensitive	Available
Marci	H	Balanced	Balanced	Balanced	Professional	NEI	Limited
Mallry	H	Process	Balanced	Wide	Professional	Sensitive	Balanced
Winnie	H	Process	Balanced	Balanced	Professional	Sensitive	Balanced
Roslyn	H	Balanced	Balanced	Wide	Balanced	NEI	Available
H-Gp		Process	Balanced	Balanced	Professional	Mixed	Available
Deena	L	Product	Automatic	Narrow	Layman	Sensitive	Limited
Chrissy	L	Product	Balanced	NEI	Layman	Sensitive	Balanced
Ronald	L	Product	Balanced	Narrow	Layman	Sensitive	Limited
George	L	Balanced	Reflective	Narrow	Professional	Sensitive	Limited
L-Gp		Product	Mixed	Narrow	Layman	Sensitive	Limited

*NEI=Not Enough Information Available

Interview Content Analysis-Time 2

Student	Classification (high vs low)	Process vs Product Goals	Reflective vs Automatic Responses	Wide vs Narrow Lens	Professional vs Student View	Contextual Sensitivity	Available vs Limited Resources
Sharon	H	Balanced	Reflective	Wide	Professional	Sensitive	Balanced
Marci	H	Balanced	Reflective	Wide	Professional	Insensitive	Available
Mallry	H	NEI	Automatic	Wide	Professional	Insensitive	Balanced
Winnie	H	Process	Reflective	Balanced	Professional	Insensitive	Limited
Roslyn	H	Balanced	Reflective	Wide	NEI	Insensitive	Available
H-Gp		Balanced	Reflective	Wide	Professional	Insensitive	Available
Deena	L	NEI	Automatic	Narrow	NEI	Sensitive	NEI
Chrissy	L	Product	Reflective	Narrow	Professional	Sensitive	Limited
Ronald	L	Process	Balanced	Narrow	Balanced	Insensitive	Balanced
George	L	Process	Reflective	Balanced	Professional	Insensitive	Available
L-Gp		Process	Reflective	Narrow	Professional	Mixed	Mixed

*NEI=Not Enough Information Available

Interview Content Analysis-Time 3

Student	Classification (high vs low)	Process vs Product Goals	Reflective vs Automatic Responses	Wide vs Narrow Lens	Professional vs Student View	Contextual Sensitivity	Available vs Limited Resources
Sharon	H	Process	Reflective	Wide	Professional	Balanced	Available
Marci	H	Process	Reflective	Wide	Professional	Insensitive	Balanced
Mallry	H	Process	Balanced	Wide	Professional	Insensitive	Limited
Winnie	H	Process	Reflective	Wide	Professional	Insensitive	Limited
Roslyn	H	Process	Reflective	Wide	Professional	Insensitive	Available
H-Gp		Process	Reflective	Wide	Professional	Insensitive	Mixed
Deena	L	Process	Automatic	NEI	NEI	Sensitive	NEI
Chrissy	L	Product	Reflective	Narrow	Balanced	NEI	Balanced
Ronald	L	Balanced	Automatic	Balanced	Layman	Sensitive	Limited
George	L	Process	Reflective	NEI	Professional	Sensitive	Balanced
L-Gp		Process	Mixed	Mixed	Mixed	Sensitive	Balanced

*NEI=Not Enough Information Available

To complete the coding process, a number of decisions were necessary. For example, students were credited with using a certain approach even if only one representative statement was made during an entire interview. If both facilitative and limiting statements were made regarding a single category (e.g., goals, range of view, etc.), students were classified as having a "balanced" approach, even though the number of statements representing each type of approach may not have been equal. Based on the rationale that even one statement indicated use of a particular approach, it was judged important to acknowledge even isolated uses of facilitative or limiting strategies. Furthermore, it would not be expected that students would make radical changes in their learning orientations in a short time period, but would change over time as new strategies gradually replaced old, less effective ones. Thus, it is likely we would see an overlap in orientations for a period of time as well as some occasional regression to more familiar patterns under stressful conditions. Additionally, change would be expected to be uneven; that is, some categories would show changes before others. The intent of these summary matrices was simply to get a rough idea of how students' approaches to case-based instruction may have changed over the course of the semester.

Group comparisons. Besides defining each student's approach in the categories presented, Table 4 also include a "group" entry which indicates the most common approach used by students in each of the high and low groups. Group entries were determined using simple guidelines. If more than half the students in the group used a particular approach, the group entry names that approach as representative of the group. If responses did not cluster within a category, the word "mixed" is used, indicating more variation among group members. The "balanced" rating, used previously to indicate that both approaches had been used by a student, was most often used as evidence to support a facilitative group entry. Although "summarizing" the approaches of individuals is not always easy or necessary, it was attempted here in order to make a comparison between different types of learners and their approaches to case-based instruction. As such, these group entries provide some insight into the similarities and differences between groups at three different times in the semester. By comparing these summaries across time, we begin to see how groups, as well as individuals, changed from the beginning to the end of the semester.

Summary matrix. A final summary matrix (See Table 5) was created by assigning a point value to each approach, so that a ready comparison could be made across time and across students. The use of a facilitative approach (e.g., process goals, reflective responses, wide lens, etc.) was assigned 2 points; a balanced approach received 1 point, and a limiting approach (e.g., product goals, automatic responses, narrow lens, etc.) received 0 points. This table allows us to see, at a glance, where the different groups of students started, and where they ended, the semester. For example, by the end of the semester all of the high students had adopted process goals, held professional views of learning from cases, and had broadened their conception of knowledge to include respecting others' opinions and valuing general, as opposed to specific, answers. One area that showed little change was that of accessing available personal resources.

Some high students still expressed concern over their lack of knowledge and seemed unable to draw on previous experiences.

Table 5

Interview Content Analysis-Summary of Time 1-2-3

(Facilitative approach = 2 pts.; Balanced approach = 1 pt.; Limiting approach = 0 pts.)

Student	Classification (high vs low)	Process vs Product Goals	Reflective vs Automatic Responses	Wide vs Narrow Lens	Professional vs Student View	Contextual Sensitivity	Available vs Limited Resources
Sharon	H	2—1—2	1—2—2	x*—2—2	2—2—2	2—0—1	2—1—2
Marci	H	1—1—2	1—2—2	1—2—2	2—2—2	x—2—2	0—2—1
Mallry	H	2—x—2	1—0—1	2—2—2	2—2—2	1—2—2	1—1—0
Winnie	H	2—2—2	1—2—2	1—1—2	2—2—2	0—2—2	1—0—0
Roslyn	H	1—1—2	1—2—2	2—2—2	1—x—2	x—2—2	2—2—2
Summary		1.6-1.3-2	1—1.6-1.8	1.5-1.8-2	1.8—2—2	1—1.6—1.8	1.2-1.2-1
Deena	L	0—x—2	0—0—0	0—0—x	0—x—x	0—0—0	0—x—x
Chrissy	L	0—0—0	1—2—2	x—0—0	0—2—1	0—0—x	1—0—1
Ronald	L	0—2—1	1—1—0	0—0—1	0—1—0	0—2—0	0—1—0
George	L	1—2—2	2—2—2	0—1—x	2—2—2	0—2—0	0—2—1
Summary		.25-1.3-1.3	1—1.3—1	0—.3—.5	.5—1.3—1	0—1—0	.3—1—.7

*x=Not Enough Information Available

The pattern of change for low students was different from that of high students. Whereas the high students seemed to make fairly steady progress toward the use of facilitative strategies, low students demonstrated much more back and forth movement. Overall, the low students demonstrated a limiting approach to the first case, yet described using a more facilitative approach for the second case. There are a number of possible reasons for this difference including changing orientations, format of the case (length of case, species involved, questions asked), increased competency with specific analysis procedures, and semester timing. At the time of the third interview, however, some low students were observed to rely on automatic, familiar responses rather than employing these more facilitative strategies. Again, there are a number of possible reasons including increased pressures from external sources (assignment deadlines, impending final exams) and the specific type of case presented. This third case was formatted somewhat differently and may have frustrated students who had been learning to analyze cases by applying a standard procedure. By providing much more information about the context of the problem (the barnyard setting) but no lab results, students had to ask more questions and determine additional tests needed before they could complete their analyses. This additional demand, at this time in the semester, may have shaken students' confidence and increased their frustration causing them to rely on more familiar strategies. Having to deal with a number of new factors at one time may have caused these students to return to what was familiar as a way of preventing cognitive, or stress, overload.

As a group, low students made promising gains in terms of the goals they established for this case-based course. Three out of the four low students included some mention of process goals in their second and third interviews, while only one student had started the semester with a process goal. This in itself is noteworthy and suggests that case-based instruction may be beneficial in helping students focus more on the learning process as opposed to the products of learning (grades, facts, task completion).

The individual learners. Table 5 also enables us to see how particular individuals responded to the case approach and to identify characteristics of those who appeared to make, or not make, gains along the self-regulated continuum. A closer look at these discrepant cases may point to specific factors which may have facilitated or limited learning for these particular learners. I provide a brief view of just a few students to illustrate the range of differences noted.

Like the other low students, Ronald started out with a fairly limited case approach, yet had showed progress in every area, but one, by the time of the 2nd interview. However, Ronald became so flustered with the third case that his performance suffered in almost every area. He recognized that having a systematic approach was important but admitted that he had not been able to be systematic under conditions which included an unfamiliar animal, time constraints, and a different case format. It is encouraging to note, however, that Ronald did not regress to pre-course levels in every area. He still mentioned some process goals and satisfaction with achieving a general diagnosis. Given a reduction of other stresses, Ronald still judged that he could be successful in future case analyses. "If I didn't have any major tasks pending I can probably do one now very confidently provided I had the resources."

Although Deena came to recognize the value of the case *process*, she demonstrated very little change in any of the other areas. Deena was never completely sold on the case method, but more importantly, was never thrilled about being part of this study. Although Deena expressed initial interest and motivation for the course, this was quickly lost when outside pressures mounted. During the first interview Deena indicated that the case method may actually hurt her study habits as she would not have as many notes from which to study. She valued traditional teaching methods (lecture and textbook assignments) and wished that the teacher would include some of these ("I don't think that you can learn just from cases. Pure lecture is important in clarifying certain concepts"). This particular response is not unexpected. In the veterinarian educational literature, Herron, Wolf, and DiBrito (1990) suggest that students may resist a problem-solving approach if they judge that it will require more effort and/or time to achieve the same results as those achieved through traditional didactic approaches. According to Ridley (1990), how a student responds to new academic demands, in terms of feeling either challenged or stressed, depends on that student's particular orientation to self-regulation. In Deena's case, her "limiting" approach, as defined here, seems to have added to her feelings of being stressed

Deena took the opportunity during the 2nd and 3rd interviews to voice her frustration and anger over having to do extra work for this study. Because the interviews required even more of her time, these were typically much shorter than with other students, and some useful information was not obtained. It is probably fair to say that we still do not know how Deena learned from cases, only how she responded to case-based instruction given these particular circumstances. What we *have* learned from Deena's comments is how important it is to make course assignments relevant and meaningful (students did not get credit for these cases), and to provide individual feedback after each (students only participated in a general discussion of each case following their analyses). Deena's criticisms can help us identify those aspects of a case-based learning experience which may be most meaningful to the participants.

Roslyn's experiences in this course stand in sharp contrast to those of Deena. Roslyn's prior clinical work, as well as her strong facilitative attitude, made case-based learning a natural for her. Despite suffering from frustrations with other courses, a lack of knowledge about specific types of cases, and a certain amount of fatigue at the end of the day, Roslyn never lost sight of the value of the case method for her career. She recognized her limitations as a learner and initiated strategies to overcome them ("My initial response was, 'Oh my, it's a large animal again.' But I just said, 'Use the steps' and so that's what I did."). Roslyn seemed to make continual movement forward along the self-regulated continuum; once a facilitative approach was adopted, there was never any indication that it had been set aside.

Sharon started out as one of the strongest learners. Her initial approach included powerful strategies such as trying to see the big picture and trying to relate new information to old. As luck would have it, the first case study involved problems that Sharon was somewhat familiar with. Her confidence and motivation were high and her analysis was strong. Although Sharon's interview comments continued to indicate great value in the method, she struggled as other pressures began to accumulate and when later cases were not as familiar. Sharon demonstrated remarkable persistence during our interviews but her last two case analyses were weak and sketchy. It is interesting to speculate that perhaps Sharon is our best example of what a self-regulated learner does when pressures become overwhelming. Sharon's motivation and persistence in the course remained high; her performance on these two optional case analyses, which provided no credit or individual instructor feedback, received much less attention. Sharon chose to use her time and effort to perform well where it was most important to do so.

General Discussion. These examples illustrate only a few of the many unique experiences that students had in this case-based course. What can we learn from such a wide range of responses? What general factors, if any, can be seen operating throughout? Of the six facilitating and limiting variables detailed earlier, the one that seems consistently influential is the type of goals students set for themselves in this particular course. This finding supports other research in the area of self-regulation which indicates that learning and performance goals may exert different effects on self-regulatory activities (reported in Schunk, 1994). In this study, students who focused on learning the approach tended not to get as frustrated by their lack of knowledge or by not achieving a single "right" answer. Every new case gave them the opportunity to practice their approach and to refine their skills. Students who adopted process goals for themselves (as opposed to just recognizing the value of the approach, as in Deena's case) remained interested, motivated, and confident in their ability to learn in this course.

On the other hand, those who adopted product goals were mainly concerned with learning more of the facts which they judged would help them problem-solve in the future. These students seemed more easily frustrated, restless, and less confident in their skills. Their overall experience in the course was tempered by this concern for doing better, knowing more, and appearing competent. This seemingly negative influence was most noticeable, not so much in terms of case analyses performances or course grades, but moreso in students' levels of comfort with, and interest in, the course as a whole and in the specific tasks at hand.

It is interesting to note that neither initial levels of self-regulation, nor number and types of strategies used, were highly related to teacher ratings of students' case analyses. There are many possible explanations for this including: students' lack of motivation for completing these specific cases; inability, on our part, to adequately discern students' use of cognitive and metacognitive strategies; varying levels of students' prior knowledge; and teacher's use of grading criteria which focused on accuracy of diagnoses (product goal) as well as analysis procedures (process goal). Zimmerman (1994) has suggested that perceived value plays a critical role in one's willingness to self-regulate. In this study, students' approaches appeared to be highly influenced by the perceived value of the course, its methods, and its specific tasks. Whereas Deena saw some value in the course, she saw little value in the method and no value in the specific tasks she was asked to complete. Other students may not have valued the specific tasks, but their strong value for the course and its methods appeared influential in maintaining their motivation and effort throughout the semester. A high value on the case approach, as mentioned above, seemed especially influential in students' development and/or use of case analysis and self-regulation skills.

Conclusions and Implications

Although case-based instruction is widely heralded as being a powerful teaching method, Sykes and Bird (1992) lament that these is no research literature that explores the nature of learning through cases. One of the goals of this study was to further our understanding of how students learn from case-based instruction. By examining students' initial and changing responses toward, and strategies for learning from, case-based instruction it was anticipated that specific learner and instructional factors which facilitate, or limit, case-based learning might be identified. By comparing the responses and strategies of different types of learners, defined by levels of self-regulation, a wide range of responses could be illustrated. Students who represented opposing ends of the self-regulation continuum would be expected, at least initially, to demonstrate different levels of comfort with, and strategies for learning from, a case approach. Examining changes in these students' responses and strategies over the course of a semester provided the means to investigate the assumption, stated earlier, that the case method of instruction might provide a viable means for fostering "reflectively intentional" self-regulation in low-regulated learners.

As expected, high self-regulated learners initially demonstrated more comfort with the case approach, as well as more powerful strategies in analyzing cases, than low self-regulators. However, initial strategy use was commonly tied to established patterns of strategy use, which for high self-regulators, tended to include higher level strategies, such as organizing and elaborating on information. Comfort seemed to be related, primarily, to the type of course goals students set. By focusing on process goals, high self-regulated students emphasized the strategies needed to analyze a case, as opposed to the facts needed to make a correct diagnosis. Schunk (1994) indicates that process goals enable students to experience a sense of self-efficacy for skill improvement and tend to engage them in activities that enhance learning (e.g., effort expenditure, persistence, use of effective strategies). As students made progress in their case-analysis approach, their interest, motivation, and confidence increased, or was sustained, for future case analyses.

In contrast, low self-regulators started the course with product goals which focused their attention on getting a grade, completing a task, or learning specific facts. These types of goals did not allow these students to consider the importance of the processes or strategies underlying successful task completion. Students seemed more concerned with getting the "right" answer, pleasing the teacher, or appearing competent. Schunk (1994) suggests that product goals may not result in a sense of self-efficacy for learning, and thus can not sustain self-regulation. However, as the course progressed, promising changes in students' orientations were noted. By the time of the second interview, these students were beginning to adopt process goals, to be more reflective, and to utilize a more professional outlook. If the study had ended at this point, we might have judged that the case method had successfully fostered the development of these specific self-regulation skills.

What happened in the remaining weeks of the semester, however, highlights the importance of contextual factors in facilitating, or limiting, students' use of these particular self-regulation strategies. Although there has been a great deal of previous research (cf., Weinstein, 1988) which has demonstrated that self-regulatory processes can be enhanced through instructional intervention, it has not been successfully demonstrated that these changes are sustained over time (Schunk, 1994). Results from this study suggest that outside pressures in students' lives may increase their sensitivity to other instructional factors (type of case, time of day, length of lab) and impede their use of self-regulation skills. This finding indicates that, although the case method of instruction may hold promise for facilitating the development of self-regulation in low-regulated students, the potential influence of contextual factors needs to be examined. In addition, the interaction between learner and contextual factors is an area which could benefit from future research.

By being aware of the effect that contextual factors may have on students' use of self-regulatory strategies, teachers may be able to alter, or eliminate, potentially troublesome factors before they are encountered. For example, teachers can help students establish process learning goals at the beginning of a course by emphasizing the strategies underlying successful case analysis. By basing grading criteria on students' ability to demonstrate use of specific learning strategies rather than bottom line diagnoses, teachers can shift students' emphasis to more process-oriented goals. Furthermore, if teachers can give students more choices in terms of types of assignments, types of cases to be analyzed (make small and large animal cases available), flexible due dates, working individually or in groups, accessing available resources, etc., students may be more capable of using self-regulation strategies. At the very least, teachers can verbally acknowledge the pressures students are encountering and thus raise levels of awareness (as a first step in the self-regulation process) and establish a supportive learning environment. Following this, teachers might model their own strategies for dealing with similar pressures.

Lindner and Harris (1993, p. 4) lament that "whether and under what conditions learners will be self-regulating turns out to be a complicated matter." By utilizing an interpretive approach with a small number of students, this study was able to examine, in depth, how high and low self-regulated learners responded to a specific instructional environment. An analysis of students' interview responses and case analysis strategies enabled us to identify some of those conditions which might have facilitated, or limited, students' use of self-regulated learning strategies. The critical factors which seemed to be operating in this study were presented in the form of a facilitative-limiting framework outlining two general orientations to case-based instruction. Within this framework, additional factors were identified which seemed particularly influential in determining students' overall experience in this case-based course. Future research should be directed toward verifying the structure, as well as further defining the individual components, of this framework. Following refinement and verification, this framework may provide other researchers and educators with a viable means for charting students' progress in the development of self-regulation skills. Given the current high interest among school practitioners in fostering self-regulation among students (Schunk, 1994), techniques for initiating, supporting, and gauging the development of self-regulations skills will be both useful and necessary.

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Title:

The Portable Usability Testing Lab: A Flexible Research Tool

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Introduction

In 1992, the Georgia Research Alliance released a "Request for Proposals" (RFP) for establishing an infrastructure for research and development focused on advanced telecommunication technologies and applications in the state of Georgia. A group of faculty (including the authors of this paper) in the College of Education at The University of Georgia responded to this RFP and obtained funding for a new R & D facility called the Learning and Performance Support Laboratory (LPSL). The four areas of emphasis in the R & D efforts of the LPSL are 1) interactive learning environments, 2) electronic performance support systems, 3) alternative performance assessment systems, and 4) information access systems.

The LPSL is committed to knowledge acquisition, theory construction, and the highest ideals of applied research and development, especially as they relate to education, training, and performance problems that must be solved to ensure the economic viability of state of Georgia. Advanced telecommunications, along with genetic engineering and environmental technologies, have been identified as the three key industries for Georgia in the 21st Century. The LPSL is committed to partnerships and collaborations with other institutions, businesses, and agencies in the state. Current partners include R & D labs and centers at the five institutions (Georgia Institute of Technology, Georgia State University, Emory University, Clark-Atlanta University, and the Medical College of Georgia) which together with The University of Georgia (UGA) form the Georgia Research Alliance (GRA). Equally important partners are other Georgia public institutions (e.g., colleges, schools, technical training centers, etc.), businesses and industries (e.g. AT&T, BellSouth, and CNN), and government agencies (e.g., the U. S. Army Signal School at Ft. Gordon). The LPSL is also establishing substantive collaborations with partners from around the USA and the rest of the world. For example, the LPSL has established a relationship with the "Cooperative Multimedia Centre" (CMC) in Perth, a collaboration involving four universities in Western Australia.

Usability Testing

To achieve its R & D goals, faculty associated with the LPSL realized that they would need state-of-the-art research equipment. One of the primary needs was obtaining a portable usability lab for software testing. According to Shneiderman (1987), usability is a combination of the following user-oriented characteristics: 1) ease of learning, 2) high speed of user task performance, 3) low user error rate, 4) subjective user satisfaction, and 5) user retention over time. Hix and Hartson (1993) and Nielsen (1993) provide guidance to evaluating user interface issues, a process known as usability testing. Usability testing is especially critical in the design, dissemination, and implementation of interactive multimedia for education, training, performance support, and information access (cf., Blattner & Dannenberg, 1992; Laurel, 1990; Polson, 1988, Shneiderman, 1987).

A proposal was written and funding for the portable usability lab was obtained in 1993. Usability Systems, Inc., an Atlanta based company that builds usability labs for testing software, responded to our request for bids for a portable system with the "Luggage Lab 2000" (see Figure 1). This lab is transportable to any site where interactive multimedia or any other type of software is being used for education, training, information, or performance support purposes. The "lab" includes a remote-controlled video camera that can be focused on the user's face, work on a desk, the user's computer, keyboard and mouse, or any other aspect of the user environment considered important in the study. The system simultaneously records the user's computer screen. Researchers sit at a control panel that allows them to observe the user(s) directly or on any of the video screens displaying selected aspects of the context. Researchers can control what is recorded, e.g., most of the user's screen along with a small insert image of the user's facial expressions or body language.

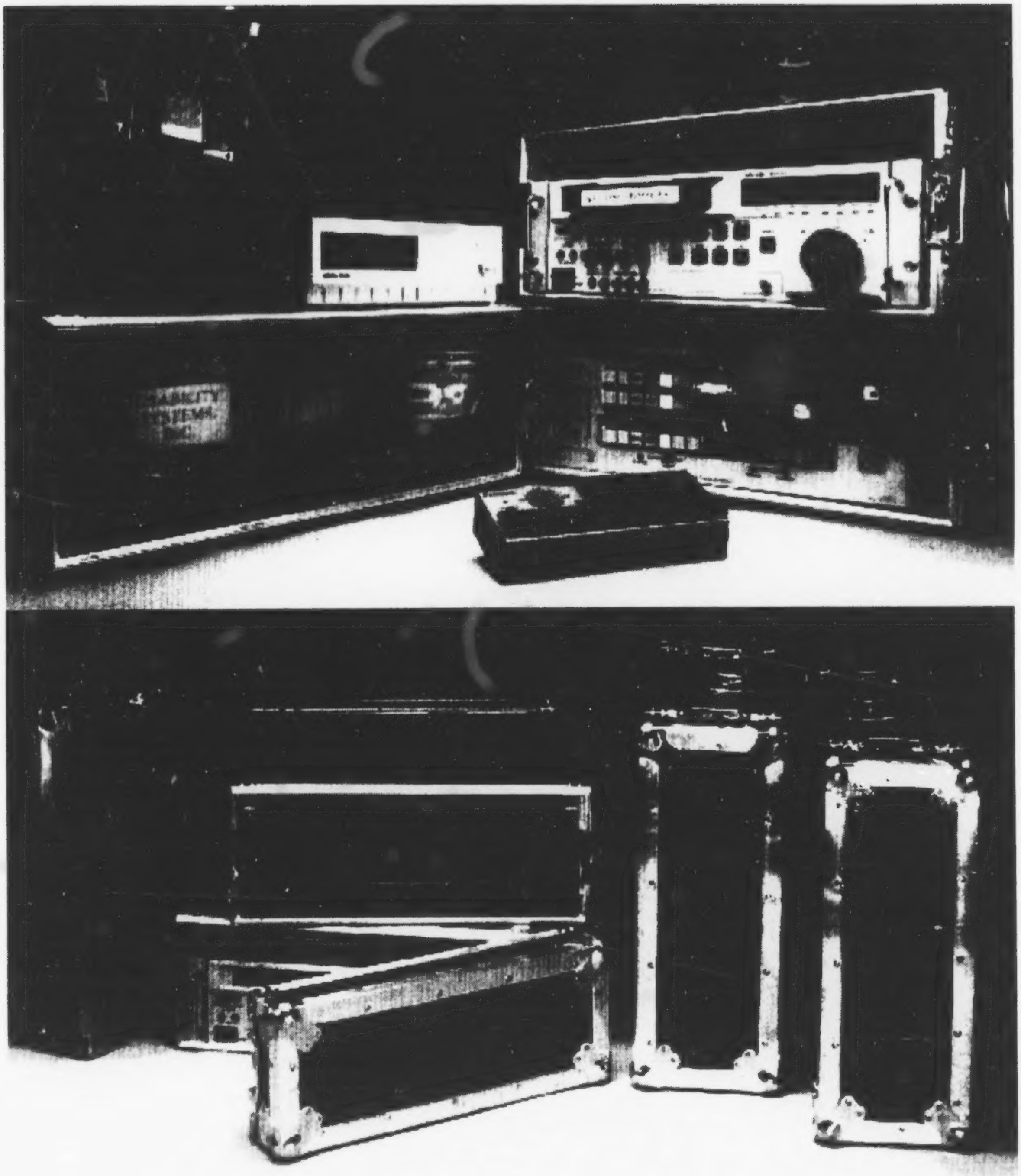
USABILITY
SYSTEMS,
INC.

Figure 1. Portable usability lab. (FMI, contact Usability Systems, Inc., 404/475-3505.)

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Commercial software developers have employed "usability labs" for formative evaluation of software applications for many years (Gomoll, 1990). For example, both AT&T and IBM maintain fixed usability testing labs in the Atlanta area. These fixed usability labs generally consist of two rooms separated by a one-way glass window (see Figure 2 below). In one room, a computer user sits at a desk and uses the application being evaluated, e.g., a new spreadsheet program. Several video cameras mounted in the room are focused on various aspects in the room. In the other room, evaluators and designers sit at control panels where they can simultaneously observe the user in the room through the one-way glass or any of the video screens displaying selected aspects. The user may be instructed to "think aloud" as he/she uses the program, e.g., talk about why certain choices are made or describe any confusion about the program's interface. Alternatively, the evaluators may question the user via headsets or speakers about why he/she has done certain actions. Typically, these sessions are videotaped for later analysis and documentation. Some fixed usability labs feature a third room where clients can observe the usability testing as it is being conducted.

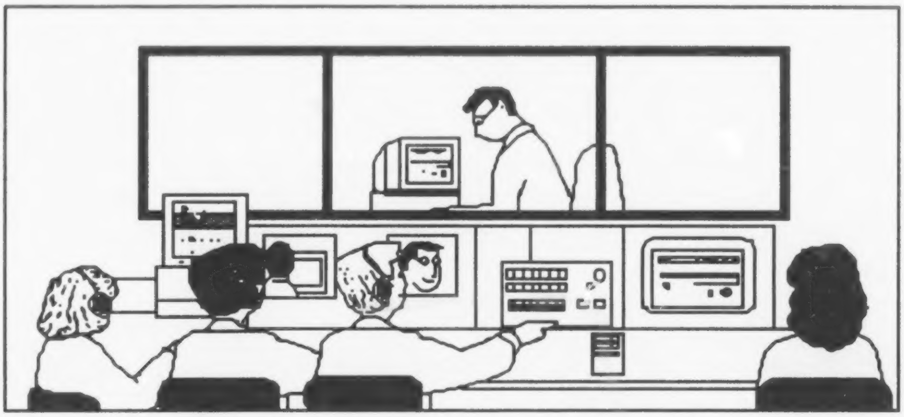

Figure 2. Fixed usability laboratory (artwork by Lih-Juan Chanlin).

The portable software usability lab is patterned after these commercial labels, but rather than forcing users to come to a lab and test software in an artificial environment, the portable lab allows the users to stay in their own environment. We believe that this increases the validity of both software testing and research studies. This paper is intended to describe our procedures for using this research tool, present some of the preliminary results we have obtained with it, and suggest recommendations for further research.

Procedures for Usability Testing

The portable usability lab enables researchers to collect both quantitative and qualitative data related to issues such as user interface, mental models, navigation, documentation utility, effectiveness, and efficiency. A variety of research and evaluation protocols are possible using this type of tool (Hix & Hartson, 1993; Nielsen, 1993).

Our usability lab comes in four large cases that stack onto a dolly for rolling (see Figure 1). Detailed instructions describe step by step procedures for connecting system components together. All cables are color coded to assist in setup. Beyond the normal components of the Luggage Lab 2000, Usability Systems, Inc. added picture in a picture capability to the lab. This allows us to record both the full computer screen and an inset of the user. An FM microphone is provided for think aloud and interview procedures. The camera has remote control features to pan and tilt for added flexibility in recording the interactions of the user.

This flexible system can be used to support and enhance many methods of usability testing. Nielsen (1993) identified the following methods for gathering usability data: observation, think aloud, questionnaires, interviews, focus groups, logging actual use and user feedback. Researchers and developers should select the appropriate methods to collect data to address different usability issues and questions.

Each of these methods has different strengths and weaknesses, and combining different methods is often necessary to improve overall usability testing. For example, you might want to ask questions to users during observations, but asking questions during an observation can change what the user would naturally do. One solution is to record the user with the portable usability lab, and later play the tape back to the user and ask questions. The tape assists the user in recalling the recorded session. In addition the same tape can be shown to human factors experts for their advice and interpretations. A focus group can review videotapes of users in their actual working conditions to stimulate discussions.

Both research projects and software evaluations can involve the use of experts to judge the performance of users on various types of tasks. Reliability is an important issue whenever human judges are used. Having videotaped data scored by multiple experts can provide reliability information about the data collection process. Collecting data about benchmark tasks is another use of the portable usability lab. A benchmark task is a common activity the user performs with the technology. These benchmarks are selected by the developer to measure quantitatively the interface design (Hix & Hartson, 1993). The usability system can record the user's performance on benchmarks for later analysis.

In addition to these planned benchmark tests, you may observe users with the portable usability system over time in their natural environment doing what they select to do. This is more like naturalistic research than benchmark evaluation. Benchmarks are focused and efficient whereas natural observation is time consuming and less directed. However, the generalizability of findings from naturalistic research may be greater. Both are valuable and can be supported with the portable usability system.

Many times in designing an interface you may have multiple options for designing an interaction with the computer. Local "rapid prototyping" is the creation of multiple designs for small components of your software (Hix & Hartson, 1993). By comparing tasks performed with each option of interacting, you can feel more confident about which design to use.

An example of multiple designs for a computer interaction was considered by the first author in the design of an angle measurement tool, a computerized protractor. One way to measure an angle is to click on three separate points that form an angle (one on the first leg, one at the vertex, and one on the other leg of the angle). Another way to design the protractor is to click on the vertex and drag along one side and release, then you push or pull to create a spanning angle that reaches the other leg (Hale, Gustafson & Yeany, 1989). The first interaction is more straight forward. The latter has the advantage of positive and negative values depending visually on the direction of spanning. By creating both versions in a small prototype, you may test these for inclusion into the final product.

Finding appropriate users who will allow you to videotape them at work with a prototype system is sometimes difficult. Experts suggest only using a few participants that match your target users (Hix & Hartson, 1993). You should supplement these by using one or two experts in human-computer interface design to review your software. With so few people interacting with your software, you may want to maximize the data you have by doing detailed analysis using a tool such as Videotape Analyzer (Tsao, Hale & Fan, 1994). This software tool supports repeated detailed qualitative analysis of video. The portable usability lab is ideal for producing videotapes that can be analyzed with this tool.

Results of Usability Testing

The usability lab at UGA was used in late 1994 for two different purposes. i.e., formative evaluation and educational research. The first application was part of a formative evaluation of a computer-based learning environment for statistics called *StatSim*. The second was to examine the types of interactions initiated by learners who were in two different experimental groups using an intelligent tutoring system called the *MSRT Tutor*. The best way to understand the power of the usability lab is to describe our experiences with these two applications.

In the case of the *StatSim* evaluation, the usability lab was used in the College of Education at UGA. Therefore, the portability part of the system was not utilized to its fullest extent. The system was setup in a small limited access hallway that was adjacent to the room where the software testing was to take place. This was quite useful in that the people who were being recorded did not actually see any of the equipment that was being used. We believe that this would have resulted in a heightened anxiety level within the people who were learning from *StatSim*. However, because there was a cinder block wall between the usability equipment and the learner, the audio transmit/receive ability was problematic. Later uses of the lab attended to this placement problem by making sure that there were no obstructions between the remote microphone of the user and the receiver built into the usability equipment. Office partitions block the view, but do not block the radio signal. Another, as yet unexplored possibility, would be to add to the lab a remote antenna that can be placed in the room where the user is located.

The intent of the *StatSim* evaluation was to improve the software. The program had been developed by Liu Zhang, a graduate student in the Artificial Intelligence Program at UGA. This program was part of his requirements for a Master's degree. Within the program, he used elements of constructivist learning theory to allow the learner to freely explore problems in statistics. However, once the learner navigated to the point where problem solving was taking place, the system was then able to model the learner's problem solving and provide appropriate feedback.

The *StatSim* program was written in Visual Basic. Many of the changes that were made to the software were the result of learners' expressed lack of understanding of particular icons, text messages, or information windows. While it would be beyond the requirements of this paper or interest of the reader to document all the changes here, it should be noted that confusing items that were presented to the learner as they interacted with the *StatSim* program were located not only by their verbal comments, but also by their facial expressions as they were being shown different aspects of the program. The videos captured by the usability lab enabled us to locate and modify these confusing items.

Curiously, during the interactions, *StatSim* caused the computer to "lock up" on a seemingly unpredictable basis. Each time this would happen, the computer was restarted and the learner continued. At first, the developer was at a loss as to why the system was crashing. Upon review of the video tape that was created by the usability lab, it was discovered that the system would crash on the fifth time that the learner would access the calculator (a resource program that comes with Microsoft Windows). Apparently, each time the learner accessed the calculator, when they were done, they would click back on a *StatSim* screen. The calculator program was therefore still running. The next time the learner clicked on the calculator, a new instance of the calculator was created. Finally, on the fifth access to the calculator, the memory was exceeded and the computer would "lock up". The video obtained with the usability lab enabled the developer to track down this peculiar problem.

A different application of the usability lab took place when we used it during an experiment with the *MSRT Tutor*. The tutor was originally developed by Michael Orey to determine if an interesting ITS like system could be built to run on a 286-based MS-DOS computer system. It has since become a primary tool for teaching soldiers how to operate the MSRT radio. It has been used by over 10,000 soldiers for this purpose. Some of these soldiers use the program as part of their formal classroom training, others use the system in the field as is needed. The experiment examined various sustainment schedules in order to help soldiers maintain procedural knowledge in memory. One group used the Tutor every two weeks, another group every three weeks, and the last group every six weeks. Not surprisingly, the two week group was better than the three week group that was better than the six week group. The question that confronted us was: What kinds of things were learners doing on the Tutor in each of these three groups? We used the usability lab to document the interactions that the learners made on the system. We thought that the differences observed would help us understand or explain the learning differences that were measured between the groups. Two learners from each group were randomly selected to use the computer that was hooked up to the usability lab. A detailed analysis was performed on each of the video tapes that were created while these learners interacted with the Tutor.

The portability of the usability lab was very helpful in this application. This experiment took place at Fort Gordon, Georgia, a ninety-minute drive from UGA. The usability lab was loaded into a small car (Ford Escort) driven by the second author of this paper. The entire system breaks down into four large suitcases. One was placed in the trunk, two in the back seat and one in the front passenger seat. A classroom at Fort Gordon was used for data collection. The computer was setup in the front of the room facing forward and the usability lab was behind the learner. We did not want to make the learner feel too much anxiety while we collected the data, but this setting required us to place the lab in the same room as the learner. On the other hand, this configuration did not have the same transmit/receive problems that we had experienced with the formative evaluation in the College of Education.

The results of the Tutor analysis resulted in two important findings. First, the six and three week groups performed many more interaction patterns, an indication that the learners were forgetting how to use the program (the six week people more so than the three week people). This type of interaction would not result in better performance on the actual task. In fact, knowing how to use the Tutor per se is of little benefit to performing the task.

The second type of interaction that was different between groups requires a little more explanation of the treatments. The two week group performed the tasks twice every two weeks for six weeks (a total of 2 X 3 or six times). The three week group performed the tasks three times every three weeks for six weeks (a total of 3 X 2 or six times). The six week group performed the task six times once on the sixth week following the initial training. In this way, we could vary the schedule while holding the number of repetitions constant. The result of this design as shown in the videos produced by the usability lab was that there were diminishing benefits on the repetitions as the number increased. The sixth time the six week group performed the task was largely a non-memory intensive effort on the part of the learner (what youth today call a "no brainer"). According to this data, one might conclude that if we were to separate the repetitions by a short break for the six week group, their effort at the task might improve and so would their performance.

This study also revealed statistically significant differences in outcomes between soldiers who performed a fixed number of problems and those that worked towards a criterion level of performance during each of their three sustainment episodes. It was difficult to understand why we would get statistical differences between the groups until we went back and examined the data on the video tapes to compare learners in each group. As it turns out, we only had data on two of subjects from the Fixed condition and only one subject from the Criterion condition. The results of our analysis are presented in Table 1. There were three primary issues or categories of behaviors that were observed during their interaction. These issues clearly demonstrate that the Criterion One person is focusing his efforts on meeting the criteria imposed by his version of the tutor. If this pattern can be generalized to the entire group, then a possible explanation for why there was a performance difference is that the criterion group appears to be focusing their attention and efforts towards meeting the criteria while the Fixed group is focusing their attention and effort more directly on learning the content of the Tutor. If this assumption is true, it is clear why we found this performance difference and it is clear that having learners perform a fixed number of trials is a preferred teaching strategy for sustainment learning.

Table 1.
Comparison between two subjects in the Fixed group and one subject in the Criterion group

Issue	Fixed One	Fixed Two	Criterion One
View of Coach	Ask if Click Coach OK; Uses Coach frequently; Says he, "needs Coach"	Says he already knows about MSRT; Feels he doesn't need Coach; Only uses Coach once	Avoids Coach; Recognizes that Coach will prevent progress
Learning Goals	Finishes the 2 passes and expresses relief; Doesn't want to do it again	Tries to finish within 5 minutes	Is totally focused on meeting the criterion for completing the Tutor
Expressions of Confidence	Creates many excuses for errors	"I'm surprised I remember"	Anticipating performance feedback, "Do I have any errors?"

While it is difficult to fully capture the entirety of the impact of the usability lab in these short anecdotes, we hope that the reader begins to understand the potential benefit of this type of research tool. We have several new research projects underway where the usability lab will have great benefit. For example, one of our doctoral students is focusing her research on the mental models users construct of an on-line public access catalog (OPAC) (Kelly, 1994). She is using the portable usability lab to record users as they perform searches on GALIN (Georgia Library Information Network) in the main library where she works as a reference librarian. She then reviews each video with a user, asking them to explain why they made certain choices. Research on mental models is an important direction in the study of user interfaces for interactive multimedia and other applications of instructional technology (Jih & Reeves, 1992; Leiser, 1992).

Conclusion

The importance of the "usability" approach to research and evaluation is considerable (Nielsen, 1993). Currently, instructional designers and researchers have an inadequate base of knowledge about how users react to and learn with multimedia programs and other types of computer programs such as electronic performance support systems (Gery, 1991). The research data yielded by the portable usability lab provides an improved basis for guiding the design and implementation of instructional technology systems. For example, we believe that the enhancement of our understanding of interactive multimedia user interfaces can improve the dissemination, implementation, and effects of using multimedia at all levels of education and training. Initial marketing of multimedia has succeeded primarily on the basis of selling the "bells and whistles" of the technology, but now school boards, superintendents, parents, and taxpayers are beginning to demand research-based evidence that multimedia enhances learning. Fundamental understanding of how interactive multimedia is used by teachers, students, trainees, etc. is an essential part of that evidence. The portable usability testing lab provides us with precisely that kind of evidence.

Background of Authors

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Title:

A Hybrid Investigation of Hypermedia Training

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Introduction

Hypermedia is a relatively new technology, and data on the most effective ways to use hypermedia in training, while steadily growing, are still relatively scattered. Hypermedia, because of its greatly expanded capabilities over traditional computer-based training, presents new challenges for designers, developers, and evaluators of training as well as trainers. Issues arise in the design, development, and delivery of hypermedia training which were not present with traditional computer-based training and therefore were not given extensive treatment either in the development of theoretical models of computer-based instructional design or in the design of such instructional materials. Examples of the additional complexities which must be addressed in designing and delivering effective hypermedia-based training include: the appropriate type and degree of structure to be incorporated into the information content of hypermedia applications; the extent and type of navigation options to be provided to the user; the appropriate role of the trainer or facilitator; and the appropriate mix of different media (text, computer graphics, computer-generated animation, still video graphics and photographs, motion video, digitized speech, other audio, etc.).

Use of Qualitative Research Methodologies

Because hypermedia training is so new and so complex, it is difficult to identify appropriate research hypotheses which can be investigated using quasi-experimental techniques. Furthermore, the complexity of hypermedia training used in trainer-facilitated group settings (the type of hypermedia training investigated in this study) makes it difficult if not impossible to control adequately for plausible rival hypotheses. For these reasons, these researchers feel that qualitative methodologies constitute a more appropriate approach for the investigation of the effectiveness of hypermedia training.

Qualitative approaches provide a broader perspective on actual applications of hypermedia training in real-world settings. This approach was chosen because the researchers recognized that, at this stage in the development of hypermedia technology, we do not have a sufficiently well-developed understanding of which variables related to the use of hypermedia are most appropriate to investigate, and how to systematically control these variables in quasi-experimental studies. Use of qualitative methodologies also represents an acknowledgment that the researcher can not, indeed may not want to, exert complete control over the training situation. In fact, attempts to impose undue control over the delivery of training may introduce distortions in the way hypermedia is used which will negatively effect the validity of the data collected. At this point in the development of our understanding of how to use hypermedia effectively for training, it seems that the most important question to be addressed is, "What is going on when hypermedia is used for training?"

Use of Computer Tracking Tools

On the other hand, quantitative data on the uses of hypermedia for training, when they can be collected unobtrusively and without artificially distorting the delivery of training, can provide the foundation for analysis which supplements the qualitative observations and contributes to their validity, or which flags results which may appear to be conflicting and which require further investigation. Of particular value is the collection of quantitative data on the extent and specific ways in which trainees use hypermedia in a specific training program. This can be accomplished through the use of computer-based tracking tools incorporated into the hypermedia application used.

Computer tracking tools can record the number and type of inputs (keyboard entry, mouse pointing or clicking, etc.) into the hypermedia program by the user at any point in the program, as well as the exact time and duration of the interaction. This information, then, provides a comprehensive record of how a specific user interacted with the hypermedia, including the paths taken by the user from screen to screen, and the type, time, and duration of the interactions.

Computer tracking tools have been used by a number of researchers for formative evaluation and for formal research on attributes of hypermedia training. Gay and Mazur (1993) described several different types of computer tracking tools, ranging from tools which produce primarily text-based lists to tools which produce graphical and/or pictorial depictions of users' actions. They described how they used these tools in the investigation of hypermedia programs developed at Cornell's Interactive Multimedia Group. Misanchuk and Schwier (1991) identified three distinct uses for computer tracking tools, the outcomes of which they referred to as audit trails. These uses included: 1) data collection for formative evaluation; 2) tools for basic research into instructional design of multimedia; 3) auditing use of multimedia in a public forum. They describe several quantitative and qualitative methods for describing and analyzing computer-generated audit trails.

The developers of the Cities in Schools (CIS) hypermedia training curriculum recognized the potential of incorporating computer tracking tools into the CIS hypermedia software early in the project. Design specifications of the hypermedia included an analysis of the types of data to be collected and the mechanisms for collecting that data automatically (Story and Harvey, 1990).

Use of Hybrid Methodologies

This paper will describe a research effort which investigated the effectiveness of the CIS hypermedia training course for senior executives of that national dropout prevention program. The study employed a hybrid methodology of qualitative techniques and computer tracking tools, in order to provide as complete a picture as possible of how the hypermedia training course was delivered and received.

The Cities in Schools Hypermedia Training Curriculum

The authors have been involved, for the past six years, in the design, development, and implementation of an integrated hypermedia training curriculum for Cities in Schools, Inc. The CIS training curriculum was developed by faculty and staff of the Advanced Information Technologies Laboratory (AITL) in Lehigh University's College of Education.

The CIS integrated hypermedia training curriculum was developed by a team which included instructional design specialists; designers and producers of video, computer, and print training materials; and experts in adult learning. Three courses, comprising a total of ten weeks of full-day training, have been developed. The CIS training curriculum is now being delivered by CIS trainers (trained by AITL staff) at the CIS National Training Institute at Lehigh University and at six regional CIS training centers around the country.

The Cities in Schools hypermedia training curriculum uses a training paradigm different from the one-person/one computer paradigm of traditional computer-based training. Instead, a novel approach to the use of hypermedia for training is employed in which the hypermedia materials are used as training resources to facilitate interpersonal interactions in trainer-facilitated group learning activities.

The CIS training course investigated for this study was the Program Operations course, designed to train senior management personnel who are executive directors of city-wide or county-wide CIS programs. The course included a comprehensive (2500-screen) hypermedia software program, a one-hour videodisk, and trainers' and trainees' printed materials. A simulated city with a CIS dropout prevention program were incorporated into the training materials. A trainer's resource book included objectives, learning strategies, and evaluation strategies for 32 learning activities which incorporated a total of 117 separate learning sub-activities.

The CIS Program Operations course supported multiple modes of learning, including:

- presentations by the trainer;
- examination of computer, print, and/or video materials by individuals, pairs, or small groups of trainees;
- small group and large group discussions;
- role playing;
- other group activities, and
- individualized, self-paced learning activities.

Design, development and delivery of CIS hypermedia training was guided by the Advanced Information Technologies Laboratory Process Model (Harvey, 1993). According to this model, learning proceeds from lower level activities (information acquisition and comprehension) to higher level (analysis and synthesis; application in simulated settings), and culminates in a systematic application of the knowledge to a real-world situation.

Purpose of the Study

The authors recognized that, since hypermedia is a new tool for training, a comprehensive body of knowledge describing how hypermedia can best be used for training has not yet been developed. In fact, the salient characteristics of an appropriate training program which utilizes hypermedia training have not yet been identified. The Cities in Schools hypermedia training course represented the collective knowledge and wisdom of the AITL development group. The purpose of the research study reported in this paper was to validate the approach taken in developing CIS hypermedia training, and to identify aspects of using hypermedia for training which would warrant closer examination. Specific goals of the qualitative component of this research study are presented in the following sections.

How is Hypermedia Used in a "Real-World" Setting?

Since hypermedia is a new technology, and the approach taken by the CIS hypermedia curriculum was novel, researchers wanted to determine and describe in detail how the hypermedia curriculum was used in an actual course delivered in a "real-world" setting.

What Characteristics of Hypermedia Warrant Further Research?

The purpose of the study was to describe, as much as possible, every aspect of the week-long hypermedia training program. Analysis of the data collected would serve as a foundation for identifying specific questions and hypotheses about teaching and learning with hypermedia which could be investigated in future research.

Specific goals of the computer tracking tools component of this research study are described in the following sections.

How Frequently and to What Extent Did Trainers and Trainees Utilize Hypermedia Materials?

The CIS Program Operations training course was designed as an integrated hypermedia training course. The hypermedia materials were designed to present information, provide guidance and support materials for comprehension and higher-level (analysis/synthesis and application activities) learning activities. The materials provided resources and tools for both trainer and trainee in the knowledge and skills required to function effectively as an executive director of a city-wide or county-wide Cities in Schools program. Trainer-facilitated learning activities included role-playing and small-group and large-group discussion used in conjunction with and as follow-up to interaction with the hypermedia materials. The researchers were interested in the frequency and amount of time specific groups of trainees spent actually interacting with the hypermedia materials compared to the amount of time spent in other activities away from the hypermedia workstations.

Which Paths Did Different Users Employ in Exploring the Hypermedia Materials?

Structures of hypermedia applications vary widely, from relatively sequential to totally nonsequential. The CIS hypermedia application investigated employed a hierarchical structure, in which computer, print, or video learning resources were grouped into learning sub-activities which addressed a specific learning objective. Ordinarily, trainers directed trainees to examine some or all learning resources for a specific learning sub-activity. However, resources for all of the learning activities were available at any time, and users could access them by selecting the main screen for any learning activity. In addition, user tools in the CIS hypermedia application included a "personal hypermedia list" option, which provided the capability to navigate directly to a computer resource which had been added to the user's personal list. Thus, each trainee's "path" through the hypermedia was potentially different. One purpose of this study was to examine the actual trainee use of the hypermedia in a week-long training program.

What Relationships Were Present Among the Ways Hypermedia Materials Were Used, the Extent and Type of Non-Hypermedia Activities, and the Attainment of Specific Learning Objectives of the Hypermedia Training Course?

Specific learning objectives are included for each of the 117 learning sub-activities included in the CIS Program Operations training course. For each learning objective, matching evaluation strategies are presented which specify criteria which would indicate that the learning objective had been met, and where to look for such evidence (for example, in trainees' comments during small- or large-group discussions, written statements by students made on activity sheets, or the trainees' written summary action plans).

Learning objectives and learning strategies are clearly specified in the resource book provided to each trainer. Since the overall goal of CIS Program Operations training is to help trainees develop the sum of knowledge and skills which the learning objectives represent, it was important to demonstrate that this goal had been achieved. In addition, the researchers were interested in whether any relationships emerged between the ways hypermedia was used in training and the degree to which training objectives were met. For example, would a higher proportion of trainees meet learning objectives when trainers made extensive use of the hypermedia than when trainers concentrated on other, non-hypermedia training activities?

Method

A hybrid methodology was employed in this study. The qualitative methodology employed was developed during two pilot tests, then refined for use in the study of a week-long training course. All aspects of this use of hypermedia were examined, including the demographics of the participants, trainees' and trainers' use of the hypermedia materials, their use of supplemental, trainer-developed materials, and the interactions among participants (on-task and off-task, during training sessions, and during social activities).

Subjects

Subjects for the study were the thirteen trainees and three professional trainers who participated in a week-long training course. The trainees, all of whom had volunteered for the course, varied widely in age, race, level of education, and amount of experience or knowledge of CIS operations. None of the trainees expressed noticeable computer anxiety.

Trainers for the course were Cities in Schools trainers. All three had extensive professional training experience, either with Cities in Schools or with other organizations. All had taught the course at least once previously, although their depth of experience with this particular course varied.

Qualitative Methodologies

The observer (Nelson) used non-participant observation, a method which is applied by many researchers in the social sciences (Delamont, 1992; Miles & Huberman, 1984). The observer took extensive hand-written notes while observing training. Observations were recorded in brief descriptions and were subsequently expanded upon. The handwritten notes were supplemented by audiotape recording. The notes and tapes were reviewed each evening, in order to identify patterns and unusual events which should be examined more closely on following days.

The CIS Hypermedia Computer Tracking Tools

Hypermedia tracking tools were designed into the CIS hypermedia applications, and implemented at the same time the application itself was developed. The tools, which were developed as SuperCard procedures, continually monitored the status of the hypermedia workstation. Interactions of any kind (key press, mouse click, viewing video, etc.) were recorded. Time of day was also continually monitored, and the time and duration of all activities was recorded.

Data from the computer tracking tools was automatically collected in a text file. Information collected for each trainee (or pair of trainees working together on the same hypermedia workstation) included:

- the time the computer was first turned on;
- the start time of each interaction session;
- the end time of each interaction session;
- complete information on any user input (keypresses, mouse-clicks, etc.), and the time of day of such interaction;
- the start time of each period when the computer was not being used;
- the end time of each idle period;
- summary data for each day's hypermedia computer use.

Data from the raw text files was transported into a spreadsheet, and cross-tabulations of total usage and tables of usage patterns were generated for each computer workstation. These data were then analyzed in order to identify possible patterns of use.

Results

Results of the Qualitative Component of the Study

Documentation of training events in the form of extensive logs and other information collected during the course of the five-day training course provided a wealth of data. Analysis of these data indicated a number of topics which will warrant closer examination in future studies. These areas for further investigation were described in detail elsewhere (Nelson, 1994; Nelson and Harvey, 1994), and will be summarized here.

Diversity of the trainees and grouping issues. The wide variation in background and experience suggests that grouping trainees of similar backgrounds and experience levels should be investigated.

Cooperative learning. Trainees working in pairs appeared to exhibit more frequent and higher quality interpersonal interactions. Requiring grouping may promote cooperative learning and increase training effectiveness.

Presentation of objectives. Trainers were inconsistent in overtly presenting objectives of learning activities. Further study is needed on whether consistently and clearly presenting objectives will increase the probability of the attainment of those objectives.

Formal evaluation of learning. Trainers varied widely in the degree to which they systematically applied recommended evaluation strategies. Since many of the evaluation strategies focused on comments during group discussions, it was difficult to assess individual attainment of objectives. Methods are needed which will provide evidence of the degree to which each trainee meets training objectives, while at the same time not hindering the flow of interpersonal interactions and sharing of learning.

Applying learning to real-world situations. Activities designed to help trainees systematically apply learning from training to their own job situations (by developing a comprehensive "action plan") were implemented sporadically by trainers. Further study of trainees after they have returned to their own job situation would indicate whether the results of training are having a significant long-term effect on trainees' behavior.

Use of supplemental trainer-developed materials. On several occasions, trainers implemented training activities of their own design in lieu of the activities included in the hypermedia curriculum. The content and quality of these materials varied widely. It remains to be seen whether the Hawthorne effect potential of trainer's using materials they developed themselves will overcome the uneven quality of those materials.

Use of print materials. Although the CIS hypermedia course attempted to integrate the use of computer, video, and print materials (e.g., by including a "Print resource" icon on each computer resource screen which dictated specific pages of print manuals), trainers only occasionally directed trainees to these materials. A study in which the use of print materials is carefully controlled and monitored would validate the usefulness of print materials in the context of hypermedia training.

Variations in trainers' styles. Trainers varied in the degree of apparent comfort with and agreement with the principles of hypermedia training incorporated into the training program. A study which would pre-assess trainers' preferred instructional styles, monitor the styles actually employed, and measure the degree of trainees' attainment of objectives, could identify the trainer styles which were most effective in specific situations and, more importantly, those trainers' styles which may impede trainees' learning. Such a study would of necessity include a larger number of trainers, and may be difficult to implement, since control of variations among trainee groups would be problematic.

Time management. Trainers in this particular course appeared to have difficulties managing training time. Estimates of time needed for specific learning activities often proved inaccurate. Logistics (e.g., limiting time spent on breaks to the specified period) also impacted the training schedule. In this case, it appears that additional trainer training is warranted, rather than a formal investigation, since the deleterious effects of poorly managed training time are obvious.

Course evaluation. Trainers evaluated trainees' perceptions of the hypermedia training course by daily "process check" open discussions and by a Likert-type reaction form on the final day of training. Each of these methods have significant shortcomings. More valid and more reliable course evaluation methods need to be developed and tested in future studies of hypermedia training.

Results of the Computer Tracking Component of the Study

The computer tracking component of this study was more exploratory in nature than the qualitative component. The computer tracking tools produced a voluminous amount of raw data. Because of the vast amount of data, data reduction and subsequent analysis have proceeded at a slower pace than originally expected. Preliminary results of those parts of data analysis which have been completed to date are presented in the following section. The completed results, when they have been compiled, will be reported in a future paper. Data are simply reported here. No conclusions are drawn from them.

Frequency and extent of use of hypermedia materials. Table 1 presents the amount of time trainees at each of six hypermedia workstations spent actually interacting with the hypermedia training materials and the total training time. The amount of time trainees spent actually interacting with the hypermedia materials was surprisingly low, ranging from no time spent using hypermedia software by one trainee on one day to a high of 20%. The overall mean usage time for all trainees over the first four days of training was 8%.

Table 1
Amount of Time Hypermedia Computers Were Used
as Percentage of Total Training Time

Trainee No.	Day 1	Day 2	Day 3	Day 4	Mean	Std. Dev.
1	9%	18%	3%	6%	9%	7%
4	17%	10%	12%	4%	11%	5%
5 & 10	12%	6%	10%	4%	8%	4%
6&9	20%	9%	9%	4%	11%	7%
8	16%	2%	7%	3%	7%	6%
11	11%	0%	6%	3%	5%	5%

Note 1. Day five of training was a half-day session devoted to trainees' presentation of action plans and course evaluation. Only one trainee used the hypermedia on day 5 for eight minutes. Therefore, analysis of day 5 usage was dropped.

Note 2. Overall mean = 8%; S.D. = 6%.

Table 2 presents the beginning and ending times of interactions with the hypermedia engaged in by trainees during the first four days of training. This table presents, in tabular form, a picture of the usage patterns of trainees.

Table 2
Usage Patterns of Hypermedia Computers During Training

Trainee	Day.	Start 1	End 1	Start 2	End 2	Start 3	End 3	Start 4	End 4	Start 5	End 5
1	1	11:07	11:41	12:46	12:53	1:05	1:12				
	2	10:20	10:57	4:07	4:18	4:51	4:56	5:30	5:43	5:56	5:58
	3	9:50	9:59	10:11	10:12	11:03	11:04				
	4	9:40	9:41	10:50	11:11						
4	1	11:05	11:44	2:43	3:09	4:47	4:58	5:09	5:11	5:46	5:56
	2	10:24	10:53	1:33	1:35						
	3	11:53	12:06	12:12	12:47						
	4	10:53	11:12	12:41							
5&10	1	10:59	11:34	2:34	2:58						
	2	10:12	10:33								
	3	10:15	10:22	10:36	10:37	12:01	12:35				
	4	10:44	11:03								
6&9	1	11:04	11:41	12:18	12:38	2:40	3:06				
	2	10:19	10:55								
	3	12:09	12:45								
	4	10:50	11:09								
8	1	11:01	11:34	2:34	3:00	4:38	4:54				
	2	1:39	1:53								
	3	9:33	9:34	12:03	12:33						
	4	10:49	11:04								
11	1	10:58	10:59	2:40	2:54	4:39	4:54	5:39	6:03		
	2										
	3	12:05	12:11	12:29	12:34						
	4	10:43	10:54	11:15	11:16						

Relationships among use of hypermedia, use of non-hypermedia activities, and attainment of specific learning objectives. Unfortunately, this portion of the study turned out to be the least effective of the entire study. The major problem which hindered collection of comprehensive and valid data relative to the attainment of learning objectives was that the trainers varied widely in the degree to which they attended to the learning objectives specified in the trainer's resource book for each learning activity, and the extent to which they carried out systematic application of the suggested evaluation strategies. On some occasions, trainers presented the learning objective for a learning activity they were facilitating, and reminded trainees that the they could remind themselves of the learning objective by clicking on the "Objectives" icon which was always present on the computer's screen. Other trainers did not present the objective explicitly, and in some cases their behavior indicated that they had not understood or were not aware of the learning objective. Applications of the evaluation strategies was sporadic at best. For these reasons, it was not possible to continue the analysis of the relationship between uses of hypermedia and the attainment of specific learning objectives.

Analysis of hypermedia paths used by trainees. Data on the type of hypermedia paths used by various trainees are in the process of being analyzed. Preliminary analysis of the data indicates that trainees often traveled extremely complex paths while using the hypermedia training materials. Categorization of these paths has proven difficult and time-consuming. A number of tools are under development to facilitate categorization of hypermedia paths. These tools, and the results of their application, will be described in a future paper.

Discussion

The volume of information collected through the qualitative component of the study proved challenging to summarize and comprehend. The results of the data analysis process, however, met the goals of the research study, in that a clear and comprehensive picture of what happened during a five-day hypermedia training program was developed. The comprehensive picture provided a foundation for identifying a number of important questions which are appropriate for follow-up study. Several of these questions can be expressed as null hypotheses which can be investigated by applying quasi-experimental techniques. The qualitative research has provided the context and laid the groundwork for more purely quantitative research.

Although the qualitative data had indicated that trainees spent relatively little time actually interacting with the hypermedia software, the picture of usage provided by the computer tracking data was surprisingly low. An overall mean usage time for all trainees over the first four days of training of 8% could indicate that trainers were not encouraging trainees to make appropriate use of the hypermedia. Qualitative data indicated that, in several instances, trainers presented content identical to that included in the hypermedia using overheads, flip charts, and lecture. On the other hand, it should be kept in mind that the hypermedia training materials studied were designed as integrated hypermedia to be used to support interpersonal interactions (role playing, small and large group discussions, etc.) which clarified and extended the information presented in the hypermedia. Follow-up activities of this type, whether appropriate or inappropriate, would not show up in the tracking data as time spent using the hypermedia, even though the activities clearly were extensions of the learning begun through interaction with the hypermedia materials.

Analysis of data generated by the computer tracking component of the study proved more challenging. The body of information is extremely large and extremely complex, particularly in regards to the depth and variety of hypermedia paths traversed by users. The flexibility provided by hypermedia materials clearly has both positive and negative aspects. In order to identify these aspects, and to optimize the use of hypermedia materials, it is necessary first to develop a taxonomy of types of paths which are used by different trainees. The relationships among types of paths, learning styles, and learning outcomes can then be investigated more systematically. One promising approach to developing such a taxonomy would be to examine the techniques developed by social scientists to categorize and analyze interactions in small groups.

The inability to formally examine the relationships among uses of hypermedia, uses of other non-hypermedia training activities, and the attainment of specified learning objectives was disappointing to the researchers. The researchers were also key members of the team which had designed and developed the hypermedia training course, and had worked diligently to develop meaningful objectives and appropriate evaluation strategies for these objectives. In addition, the researchers were keenly aware of the importance placed on achieving specific learning objectives by the Cities in Schools administrators who coordinated the CIS hypermedia development project. Cities in Schools had invested considerable resources in the hypermedia training curriculum, and it was important to demonstrate that these resources had been invested wisely.

Conclusions

This qualitative study of a hypermedia training program treated a particular group of trainees and trainers engaged in a particular training program as a "culture" to be investigated through intensive and careful observation. The data gathered, as in most qualitative studies, is voluminous, and requires extensive and careful analysis in order to extract useful patterns and to draw meaningful conclusions. Since each group of trainees and trainers and each training program application is different, it is not appropriate to extrapolate the results of this study to all training programs using hypermedia application.

Qualitative studies are, however, extremely useful for providing a comprehensive picture of what actually happens in a "real-world" training situation. This picture provides a solid foundation on which to develop questions for further study, which can then be investigated systematically using quasi-experimental methodologies.

Computer tracking tools, to be implemented, require considerable programming expertise and effort. In addition, they are most efficiently implemented if they are incorporated into the design of the hypermedia application and implemented as the hypermedia application itself is developed. Difficulties inherent in allocating scarce project resources to develop tracking tools, including the challenge of incorporating tracking tools while meeting pressing delivery due dates, makes it difficult to implement tracking tools on a wide basis. In addition, it is extremely difficult to add tracking tools on a post hoc basis, especially by people other than the group who originally designed and developed the hypermedia application. For these reasons, tracking tools have not, to date, been used extensively in hypermedia research.

These researchers believe that computer tracking tools hold great promise for providing insights into how hypermedia applications are actually used and how they can be used more effectively. These tools are particularly effective when their use is combined with other research methodologies, such as qualitative investigations of specific hypermedia training courses. Both qualitative research methodologies and computer tracking methodologies hold great promise for furthering understanding of how hypermedia can be designed for effective training. Both have the advantage of being applied in "real-world" settings, studying actual applications of hypermedia as they are actually being used without distorting that application by their presence. When used in combination, qualitative research methodologies and computer tracking methodologies provide a synergistic extension of the information provided by each, and therefore provide a comprehensive and powerful foundation on which to base future decisions about the design and delivery of hypermedia-based training.

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Title:

Raising the Level of the Debate: The Effects of Computer Mediated Communication on Group Dynamics and Critical Thinking Skills

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Introduction

The typical class in almost every educational situation (K-12 as well as most graduate education) is measured in terms of contact time i.e. the time the teacher is interfacing with the students. Computer Mediated Communication involves the use of the computer to initiate and respond to issues via an e-mail software application in conjunction with a network connection. The advantage of this communication modality is that participants can be and usually are separated by space and time. This means that student questions and concerns about erudite concepts recently encountered during study or reflection of class discussions can be addressed while the issue is fresh in the student's mind.

Computer Mediated Communication (CMC) can increase contact time as well as provide an opportunity for the student to address issues to the teacher and his/her peers after the concept, issue or problem is presented. CMC also enables the student to practice developing their own communication styles using the instructors as consultant/advisors (Philips and Santoro, 1989). Perhaps the most powerful advantage of CMC is that it provides the opportunity for students and faculty to clarify concepts. The use of CMC in a course provides for discursive feedback stripped of all the roles, gestures, body language, and other nonverbal forms of interaction that color meaning. In addition, CMC allows the students to see, reflect, ruminate, refute and structure the CMC discussion points. It makes the discussion tangible by making it visual. Small conceptual nuances can be missed in discussions infused with social and personal contexts. Viewing the argument makes the concept concrete for student review with CMC.

Finally, CMC allows tracking of the concept discussions in a historical or chronological fashion. This can also be a disadvantage as communications are received in a chronological order and a student signing on to e-mail tends to respond to the questions in the order they are received. If a student does not stay current on a daily basis with the communications he/she may find themselves well behind in the discussion. The student needs to be engaged in the activity. Scardamalia and Bereiter termed this engagement "intentionality" and has identified it as an important variable in the use of Computer Mediated Communication (Scardamalia, M., & Bereiter, C. 1989). This engagement or "intentionality" is, of course, important for all learning.

Factors

Factors that facilitate the use of Computer Mediated Communication in decision making situations are well established. McLeod states that computer mediated communication systems typically increase decision quality, time needed to make a decision, equality of participation, and degree of task focus. However, studies also show that CMC in decision making decreases consensus and satisfaction (McLeod, 1992). These same factors are important in the learning situation. The frequency of participation in small groups is, however, related to the social context, group composition, role of the leader, norm regarding student participation and the goal of the meeting (Stephen & Mishler, 1952). No studies currently address the issues of the level of the debate or the effect of computer mediated communication on the group interaction. Issues of quality of interaction and contribution are more related to group feeling. The major premise of this study is that having students engage in computer mediated communication will increase the cognitive level of student discourse by allowing students to reflect on difficult concepts on an as needed basis. In addition, this e-mail interaction will produce a positive group feeling and movement of the class toward closer personal relationships. Lewin identified several factors which impact on the group dynamic and can be applied to the analysis of CMC interactions. He elaborated these dynamics as "field theory."

Field theory considers components of group interaction based on several factors. These factors include spatial factors, systems of tension and field forces. Spatial factors are geometric adaptations of space of free movement, both physically and intellectually. The second class of concepts is anchored in dynamic psychology of the individual (e.g., need, aspiration level, satiation). These latter concepts for the most part refer to systems of tension within the person himself. Pressures within the individual and pressures emanating from the surrounding field are termed field forces (motives clearly depending upon group pressures) barriers (obstacles to individual action owing to group restraints), or locomotion (changing of the individuals position with reference to the group) (Allport in Lewin, 48). Lewin suggests that the group dynamics are controlled by the balance between these forces. By extension, analyzing the group for these perspectives will aid in understanding both the dynamics and productivity of the group. This study is primarily based on these factors.

Field Theory

Field theory is a conceptual framework for modeling the "psychological forces" influencing individuals at any given instant.(Diamond, 92). According to Lewin (1942) there are six attributes of field theory that are particularly important:

1. The use of a constructive method
2. A dynamic approach
3. An emphasis upon psychological Processes
4. Analysis based upon the situation as a whole
5. A distinction between systematic and historical issues
6. A mathematical representation of psychological situations.

Lewin used these attributes to analyze and describe group dynamics in many situations. A short discussion of these attributes follows.

In the constructive approach elements are grouped according to their relationships. The elements we will consider are "life space", "field forces" and "tension systems"(figure 1). The life space of an individual consists of the person and the psychological environment that exists for him or her. Behavior according to Maruyama(1992) is a function of that person and that person' environment. According to Shaw(1982), it is the totality of all psychological factors that influence the individual at any given moment. In a similar manner, the life space of a group consists of the group and the environment as it exists for the group at the time. Therefore the behavior of any individual or group is a function of the person/group and the person/group environment. Individual life space is differentiated into regions and dependent on unique variables of the individual. It has two additional dimensions.

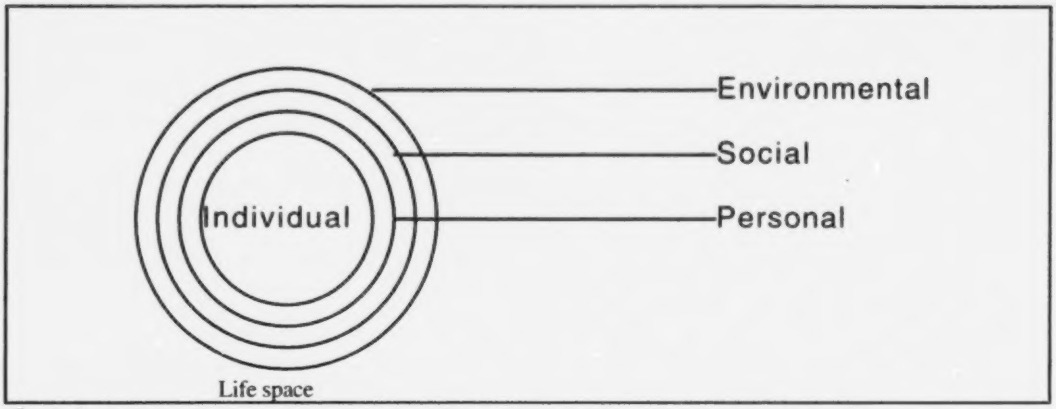

figure 1

The first is the fluidity of the system which is the degree to which regions are distinguishable from each other and its reality/irreality characteristic. If the boundaries are rigid and very different then fluidity or ease of movement from on region to the next is limited. This tends to force choice.

The second is the level of irreality which involves imagery and fantasy, whereas the level of reality involves more objective aspects of the life space. The level of reality in the psychological future corresponds to what is expected, whereas, the level of irreality corresponds to the fears for the future. Dynamically, the level of irreality is more fluid and more closely related to the central layers of the personality that the level of reality(Shaw, 1982).

Behavior is identified as the movement or locomotion of the person in life space. There are different types of locomotion: include bodily locomotion, or approach or avoiding goals(psychological locomotion). Locomotion, according to Shaw, may be produced by a need, which corresponds to a tension system in the inner-personal region. The extent to which the need will produce locomotion depends in part on the degree to which the inner-personal region is in communication with another region, where two regions are said to be in communication if a change of state in one region produces a change of state in the other region. If two regions are in communication and a need is aroused in one of the regions, locomotion from that region to the second occurs until a state of equilibrium is reached, that is, until the opposing forces in the two regions are equal in strength.(Shaw, 1982)

A force is defined as that which causes change (Lewin, 1936). Its properties are strength, direction, and point of application. Thus for any given point in the life space, the construct force represents the direction of and tendency to change. A number of forces can act on the same point at any given time, and the combination of these forces is called the resultant force. This is the effective force operating to determine behavior. When the resultant force is greater than zero, there is either a locomotion in the direction of that force or a change in the cognitive structure that is equivalent to locomotion. Conversely, if a locomotion or change in structure occurs, resultant forces exist in the direction of that change (Lewin, 1946). The strength of force toward or away from a goal is a function of the strength or the valence and the psychological distance between the person and the goal.

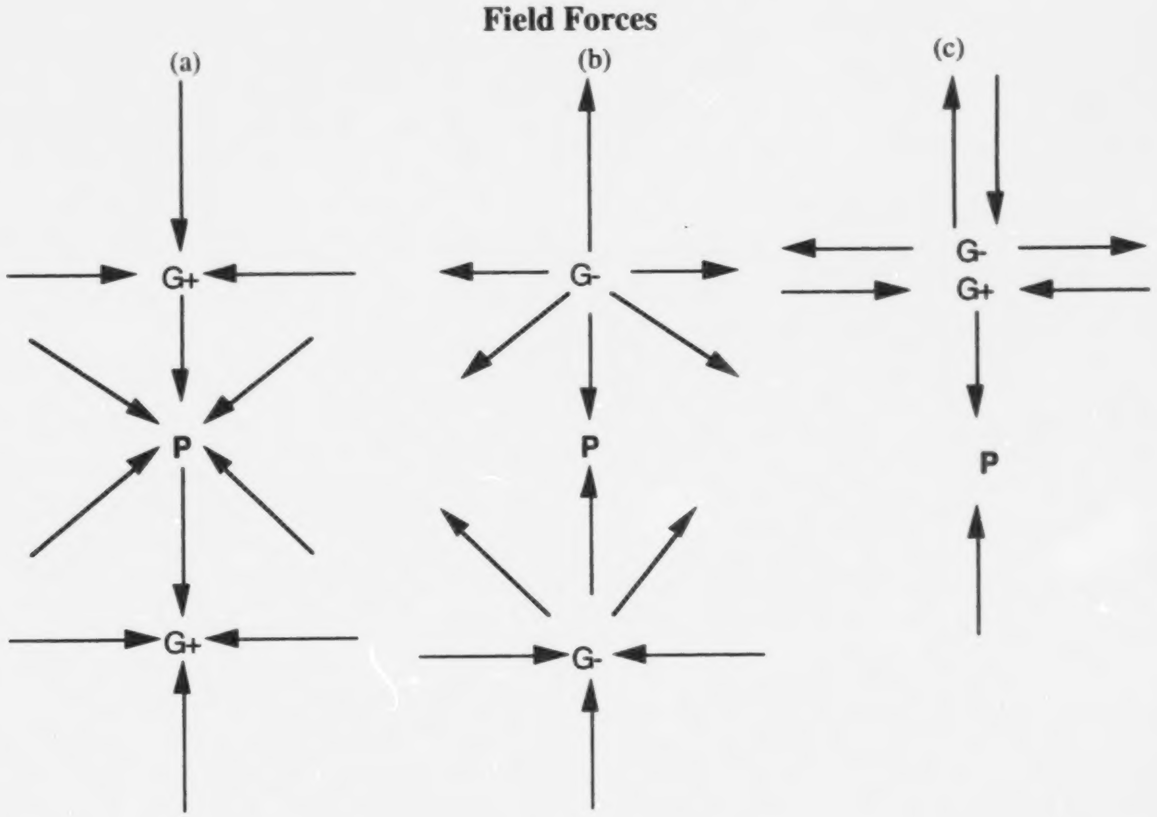

Figure 2 (a) A force field corresponding to two positive valences: (b) a force field corresponding to two negative valences: (c) a force field corresponding to a positive and a negative valence in the same direction.(Shaw, 82)

Lewin identified several types of forces: driving forces, restraining forces, induced forces, forces corresponding to one's own needs, and impersonal forces. Forces toward a positive or away from a negative valence are called driving forces because they lead to locomotion (figure 2). However, locomotion may be hindered or prevented by physical or social obstacles or barriers. Such obstacles are called restraining forces. They do not lead to locomotion but they do exert an influence on the effects of driving forces (Lewin, 1946).

In any life space tensions exist. When the strength of one set of tensions is stronger than another, movement or locomotion from or toward that region may be instigated. This locomotion results in change. When regions are highly permeable (i.e. no rigid boundaries between regions) the change can be systematic across several regions. These concepts will be used to interpret the dynamics observed in the study.

Each student has their own life space and interacts with other student's life space in class with all the social trappings. As a student, each is in a competitive environment with others in the class. A goal of the class is construct a similar mental model of the subject matter in each student. This is traditionally done through lecture, assigned readings and classroom discussion. The idea is to get the student to move cognitively toward this mental model by reducing the barriers to that movement. By stripping away the social environment and reducing the language/speaking barrier using CMC it is assumed that the student will be freer to make that cognitive movement towards the mental model i.e. making one set of tensions stronger than the other. In addition, the time to reflection will result in the student creating a realistic argument for a particular set of beliefs as they develop their conceptual model. Therefore, the student will tend more toward evaluating the concept in their discussion than just summarizing others thoughts.

Methodology

The target population for the research consists of seventeen adults enrolled in a course entitled, "Designing Cognitive Learning Environments" at The Pennsylvania State University in the spring of 1994. The goal of the proposed project was to research the effect of computer mediated communication on group dynamics according to "field theory."

Discussing class concepts via e-mail was a stated requirement of the course. Students were encouraged during regular class meetings to participate and discuss issues via e-mail. Interesting discussions were continued during the regular weekly class meetings. Two communication packages were available to the students. Pop-mail which provided a word processing type interface and PSUVM which provided more of a command line type interface. The choice of communication packages was left up to the student as was getting an access account.

Two questionnaires were administered to students. The first questionnaire, early in the semester, gathered data concerning hardware, software, existing personal relationships, personal data, biographical data, type of e-mail communication package, access to computers, types of computer available, location of access, problems with access, and spatial relationships. The second questionnaire administered at the end of the course gathered data concerning current spatial relations, systems of tension and field forces. All class communications were saved. A protocol was developed to analyze the communication in terms of the level of interaction, direction of interaction, and communication relationships. Electronic mail communication was analyzed in terms of criteria adapted from the cognitive activity levels as discussed by Jonassen in Mindtools (Jonassen, 94).

Jonassen identified nine cognitive activity levels. These levels are evaluating, analyzing, connecting, elaborating, synthesizing, imagining, designing, problem solving and decision making. These terms are defined by Jonassen as follows:

Evaluating	assessing information, determining criteria, prioritizing, recognizing fallacies, verifying
Analyzing	recognizing patterns, classifying, identifying assumptions, identifying main ideas, finding sequences
Connecting	comparing/contrasting, logical thinking, inferring deductively, inferring inductively, identifying casual relationships
Elaborating	expanding, modifying, extending, shifting categories, concretizing
Synthesizing	analogical thinking, summarizing, hypothesizing, planning
Imagining	fluency, predicting speculating, visualizing, intuition.
Designing	imagining a goal, formulating a goal, inventing a product, assessing a product, revising a product.
Problem solving	sensing the problem, researching the problem, formulating the problem, finding alternatives, choosing the solution, building acceptance
Decision making	identifying an issue generating alternatives, assessing the consequences, making as choice, evaluating the choices.

Since the purpose of the study is to identify higher levels of cognitive activity due to reflection the categories of problem solving and decision making were discarded as irrelevant to the study.

Analysis

A questionnaire was given to the students participating in the class. The questionnaire was administered at the last class meeting. The data collected included the following:

- The quality of interaction each student had with their classmates at the beginning of the semester and the quality of the interaction at the end.
- Experience using the listserve.
- The perceived effects the conferencing had on student learning.
- The perceived effectiveness of the experience in facilitating learning.
- The frequency of signing onto the listserve.
- What the student did with the messages they received.
- Did they read the messages on-line?
- Self ranking on a Introvert Extrovert scale.
- Self ranking on reflective or active learning style.

In addition, class electronic communications were collected by listing out all the communications on the listserve. These were organized according to level of interaction and communication pattern(i.e.. who was involved in the discussion)..Data collected from the questionnaire were entered into a database along with the abstract rankings of the messages and frequency of interaction. Correlational analyses were conducted.

Discussion

During the fifteen weeks of the course 178 messages were generated for discussion by the students. Seven separate themes were discussed in the context of "constructivism". The length of the messages varied as did the complexity. The messages were sorted by the major theme. These were then evaluated by several independent evaluators as falling into one of the categories of cognitive activity as outlined by Jonassen. Chatty messages that did not fall into any of the categories were labeled as Not Applicable. The message content was distributed as follows:

Evaluating	14
Analyzing	41
Connecting	30
Elaborating	17
Synthesizing	51
Imagining	09
Designing	02
Not Applicable	14

The discussion items tended to move up the rating scale as the student became an expert in dealing with the issues over time. This trend would seem to support the contention that the level of debate was rising throughout the term. However, it is not clear what role using CMC had in this trend.

The students overcame significant barriers to using the interface effectively. At least two different e-mail systems were available for students. These had very different user interfaces with one being difficult to use. The other was more forgiving and utilized the standard features of a word processor. Several students indicated that they had trouble getting on to the e-mail system from home and several could only read messages at the university. Other difficulties mentioned included:

- difficulty down loading messages to disk
- getting a hard copy of the messages
- jumping into the middle of a discussion to make a point when the conversation has moved beyond that point
- too many messages
- don't have enough time to read the messages

Students indicated that they felt that using CMC as an out of class activity enhanced information exchange and gave them time to reflect on the issues under discussion. They also stated that it gave them time to resolve issues prior to attending class. Students were also able to go back to their resources and reinforce the argument that they were making in class. It also gave them more concrete information about what other students were thinking about the subject. CMC argument were generally more organized and referenced than the oral arguments in class.

Most participants accessed their mail on a daily basis, but were more likely to respond to the discussions on the day of the class. This proved to be a disadvantage for some students as they may not have seen some of the discussion points before they arrived at class. An interesting side bar was that most of the participants did not read the messages on-line, but rather printed them out before reading them. So much for the cost savings in paper. Another interesting highlight was that some participants would create their responses in a word processing environment and transfer it to e-mail so that it would be spell checked prior to being sent.

Most students began the semester with few personal associations among the group and although some group work was required, most of this was accomplished via the computer. It was assumed that group dynamics and a feeling of personal closeness would be facilitated by CMC discussion of issues relevant to the participant. Spatial grouping indicated that students who participated in the electronic discussions ranked other participants as closer to them than the students who were less frequent participants. Students tended to elaborate the concepts from a personal perspective drawing upon prior knowledge more than doing extended readings to support their individual viewpoints. This tendency caused more advanced students to comment on a lack of depth to the CMC. Students who took an adversarial role in the CMC discussions tended to show less growth on the group dynamic scale. The spatial maps also indicated that several group members were not engaged in the CMC discussions. These same students tended to be less likely to participate in class. Discussion initiators tended to be the least experienced in the content area. Those more familiar with the content tended to contribute by connecting the issues and clarifying discussion points rather than initiating the discussions.. Students with language difficulties(English as a second language, ESL) tended to participate at a higher cognitive level using CMC than in class, but still tended to be among the least frequent users.

At the onset CMC discussions messages were more likely to fall in the lower levels of cognitive activity scale of not applicable, designing, imagining and synthesizing, while later messages were in the connecting, analyzing and evaluating categories. This indicates that some raising of the debated did occur. This may be largely though the mentoring activity of the professor, who would respond to messages by making connections for specific discussion questions and not just a result of have the CMC function available to students. Barriers to communication were also reduced by the professor's frequent reinforcement to student communications. Conceptual movement for students involved in a topic was also evidenced by the quality of the communication change from lower to higher cognitive activity levels.

Conclusion

Eighty-four percent of the students felt that the CMC caused them to move in a positive direction in the both the personal and cognitive areas. However, requiring students to discuss topical issues after class using e-mail as a CMC device is an insufficient situation for increasing critical thinking skills and affecting the group dynamic. The number of variables affecting student behavior are numerous and overcoming barriers to personal and mental growth must be addressed in a more systematic way. Some barriers to movement included: the CMC interface, time to read; time to formulate a response and address as many as twenty separate concepts in addition to all the other class responsibilities; and student individual differences. The CMC interface can be a considerable barrier to personal and cognitive movement.

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Title:

Technology for Teachers: A Case Study in Problem-Centered, Activity-Based Learning

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Introduction

Traditionally, technology classes have been taught in lock-step fashion, moving from technology to technology, emphasizing mastery of specific skills. While this method has proven effective -- at least in relation to short-term use of the technologies -- we were interested in creating a different learning environment for teaching technology to teachers. In redesigning the course, we employed a problem-centered, activity-based approach where technologies are "anchored" in authentic and familiar problems in which teaching and learning occurs. This approach is one based on the view of an open learning environment where the learners have direct input for the direction of the course. It is a problem-centered, activity-based approach to teaching various technologies to address everyday teaching and learning problems.

Teaching the technology in this manner creates a new learning environment, with different requirements and expectations not only for the learner, but for the instructor as well. In this paper, the implications of teaching a course in this manner will be discussed. An overview of the course will be provided, including the theoretical foundations underlying the learning environment. Participants, goals and objectives, as well as requirements of the course will be presented. Discussion of moving theory into practice in the actual implementation of the course will be explored. Promises, problems and issues in relation to teaching in this type of learning environment will be discussed, both in relation to the learner and the instructor.

Background

Technology for Teachers, first offered in the spring of 1994, is focused on creating the conditions under which people typically work to understand everyday things: first developing a need to learn, then satisfying the need. We work to create "needs to know" by referencing issues for which the learner has already acquired significant expertise, and examining how technology can help the learner address these issues. Several factors contributed to the way the course is currently taught. These include: a desire to create a context for learning, wanting to teach the way people learn, learners entering the classroom with a variety of experience, a different view of "technology" and a desire to create a "hands-on, minds-on" environment for learning technology.

Creating a Context for Learning

The educational community has seen an influx of technology into the classroom. However, the technology growth has not been paralleled in use and integration of technology into the everyday classroom experience (Carr, Novak, & Berger, 1992; Glenn, 1993; Handler, 1993; Ingram, 1992). Educators continue to fall behind the technology curve, with adoption resistance a predominant theme. While researchers working in teacher education have noted potential causes, ranging from lack of modeling to lack of skill, a fundamental component in the lack of adoption appears to be the lack of a mental model for integration of the technology.

In working toward integration, we moved away from a primary focus of technology skills to one of technology integration. To create this atmosphere, the course centers around creating a context for learning. The participants gain experience in the educational uses of "things" such as computers, interactive video and electronic communication; the experience is gained by applying use of the technology to practical problems encountered in everyday teaching. The technology is not presented as **the** solution, but rather **a** solution -- a way to make processes and tasks easier for the teacher, learner, and parents.

Teaching in the Way People Learn

In addition to creating a context for learning, we were also guided by a desire to teach the way people learn: developing a need to know, then satisfying the need. The course centers around problems and issues encountered in the everyday classroom. The participants work toward solving the problems, taking into account multiple points of view and using a variety of technologies. The course focuses on empowerment of the learner: they create their own goals and define the problems they want to solve.

Different Levels of Experience

The participants in the course are primarily Pre-K to 12 teachers. While the learners share a common interest in education, their experiences with technology are quite diverse. Some enter the classroom with little to no experience; others with considerable experience in many of the technologies discussed in the course. This left us with the challenge of accommodating a variety of experiences, working to keep one group from feeling overwhelmed and the other from becoming bored.

"Technology" beyond "Things"

Another factor contributing to the way the course is designed is a broadening of the view of "technology." The course focuses on emerging visions of schooling, teaching, and learning. Included in these visions is a varied role of technology for supporting the visions. Technology is defined more broadly than "things" and "media." Technologies, in the context of the course, are defined as practical methods used to accomplish practical goals -- the organized means used to accomplish diverse ends. The course is not so much about computers as it is about using technologies in a broader sense. While some approaches to the problems presented focus on how the technology can create new ways to accomplish existing goals, others emphasize new ways to exploit roles that have traditionally been untapped.

Creating a "Hands-on, Minds-on" Environment

As in most technology courses, there is a focus on creating a "learning by doing" environment. To afford the learners with a hands-on opportunity, the course takes place in a networked lab environment utilizing Macintosh-based technologies. It is an ideal setting for learning the technologies: having several technology tools readily accessible makes it easy to demonstrate ideas, present information, tap into telecommunications capabilities, and naturally integrate technology into the activities of the course.

The lab is also used to enhance a "minds-on" environment. The learners are presented with a variety of technologies, as well as a learning environment where exploration, inquiry, and discovery are modeled and encouraged. Use of the network is an integral part of the course. From the first class meeting, learners are exploring the network, discovering where tools for the course are located and feeling their way around the new environment.

In addition to the factors leading us to design *Technology for Teachers* in the way it is currently taught, there is an underlying theoretical foundation: open-ended learning. The theory and its principle assumptions will be discussed in the next section.

Theoretical Foundation: Open-Ended Learning Environment

Interest in "unleashing" the capabilities of technologies to create learning systems that differ from traditional directed instruction has recently grown. In addition to the interest in integrating technology, we also wanted to create a learning context couched in the principles of open-ended learning environments (OELEs). The factors influencing the design of *Technology for Teachers* made this type of learning environment a viable solution for meeting the requirements.

Despite the growth in interest in technology-based learning environments, we were not generating a new learning environment free from controversy. Considerable disagreement exists related to the viability of open-ended learning and the systems that reportedly facilitate it. Advocates point to benefits such as increased flexibility and utility (Spiro & Jengh, 1990; Spiro & Feltovich, 1991), and improved individualization of knowledge, as evidence for the promise of technology in user-centered learning (Cognition and Technology Group at Vanderbilt, 1991). Skeptics, on the other hand, question what is actually learned via open-ended systems suggesting that effectiveness claims may prove impossible to validate (Dick, 1991). The challenge remains for bridging the divergent views on the topic.

Defining Open-Ended Learning Environments

A significant problem in this debate has been the vagueness with which open-ended learning and open-ended learning environments (OELEs) have been characterized. Contributing to the vagueness is a lack of common definition or understanding of open-ended learning and OELEs. Perhaps the best way to understand open-ended learning is to contrast it with directed learning. Directed learning involves the systematic acquisition and retention of externally-defined knowledge and skills. An individual is a successful directed learner when he or she is able to utilize the strategies and features provided by the instructor to acquire prescribed knowledge and skills to acceptable levels.

Open-ended leaning refers to processes wherein the intents and purposes of the individual are uniquely established and pursued. It involves the individual determination of what is to be learned, how it is to be learned, when (or if) learning goals have been met, and what (if any) subsequent steps might be taken. Any number of things might be candidates for individual learning; the intents and goals of different learner would likely vary substantially. In effect, the fundamental difference between directed and open-ended learning is in who determines what is to be learned and what steps are taken to promote learning, including the resources consulted, both internal and external, during the learning process.

Cognitive Principles Underlying OELEs

The assumptions of open-ended learning are not merely cosmetically or semantically different from assumptions of traditional instruction, but are fundamental shifts in how the learner, knowledge, and the structure of the environment are conceptualized. While significant variations among open-ended learning environments are apparent, they also share several common assumptions which are manifested either explicitly or implicitly within the environment. Several critical assumptions and accompanying beliefs, adapted from previous research (Hannafin, Hall, Land, Hill, 1994), can be identified.

Context and experience are critical to understanding. Open-ended learning environments view the processes of learning and the context in which it occurs as inextricably tied. Open-ended environments embed learning activities in authentic contexts -- as concrete instances reflecting problems to be solved -- in order to foster thinking that originates from personal and practical experiences (Roth & Roychoudhury, 1993).

Understanding is individually mediated. In open-ended learning environments, the learner judges what, when, and how learning will occur -- beliefs influenced heavily by constructivists who emphasize the importance of constructing personal meaning (Guba, 1990). Self-directed learning requires the learner to assume individual responsibility for the learning process: asking relevant questions, pursuing needed knowledge, evaluating learning experiences, and so forth. Learning, in this manner, is thought to be less passive, less compliant, and less dependent on external direction than learning from traditional instruction (McCaslin & Good, 1992). The challenge comes in determining how best to support and guide these highly individualized processes without imposing unnecessary, potentially conflicting, external structures.

Cultivating cognitive processes is often more critical than generating learning products. Open-ended environments are designed to support higher-order cognitive skills such as identifying and manipulating variables, interpreting data, hypothesizing and experimenting (Roth & Roychoudhury, 1993). Their open-ended nature reduces the emphasis from specific content and rule-based knowledge in favor of self-reflections and thought-based action. This focus requires learners to use cognitive and metacognitive strategies extensively. Perkins (1993) refers to the notion of "executive function" in describing the self-directed process of making decision, monitoring thinking, and constructing understanding. Open-ended environments provide opportunities for learners to attend to things they perceive as relevant, decide for themselves and evaluate their own thinking.

Understanding is more vital than knowing. Much of the criticism surrounding traditional instruction is that it often stresses recalling information rather than understanding complexities (Spiro, et. al., 1991). Open-ended learning environments immerse learners in experiences that foster understanding through extended exploration, manipulation and opportunities to "get to know" an idea, rather than simply being told about it (Papert, 1993). Interactions emphasize the underlying reasons "why" an idea or concept exists instead of simply acknowledging or accepting its validity. Understanding is augmented by personal experiences, points of view, and cognitive scaffolding.

Qualitatively different learning processes require qualitatively different methods. The goal of many open-ended learning environments is to immerse learners in rich, cognitively-complex experiences by providing various tools, resources, and activities with which to think. OELEs focus on problem-solving skills in authentic contexts, affording opportunities for exploration and theory building (Schwartz & Yerushalmy, 1987), and providing multiple -- sometimes complimentary, sometimes competing -- perspectives (Language Development and Hypermedia Research Group, 1992). Gagne (1985) was instrumental in acknowledging that varied types of learning require differential instructional goals and activities. Gagne and Merrill (1990) noted that conceptually complex learning goals are often difficult to achieve with traditional instructional approaches. Multiple context, purposes, resources and representations of knowledge may be necessary in order for learners to engage in complex and ill-structured learning (Spiro, et al, 1991).

Guided by the theoretical foundations of OELEs, as well as the factors motivating us to seek a new way to approach teaching technology, *Technology for Teachers* was created. Unlike other applications involving OELE principles, such as the *Jasper* series at Vanderbilt (Cognition and Technology Group at Vanderbilt, 1992) and *Intermedia* at Brown University (Yankelovich, et al, 1988), *Technology for Teachers* is based in real-time, involving the continuous interactions of humans. Specifics of this implementation are discussed in the next section.

Technology for Teachers: OELEs in Action

The educational climate, in combination with the externally defined requirements and our interests, made the design of *Technology for Teachers* as an OELE possible. Components of the course will be discussed in the following sections. This includes a general overview, participants, goals and objectives, course requirements, and grading procedures.

Course Overview

Technology for Teachers attempts to create the conditions under which people typically work to understand things: developing a need to learn, then satisfying the need. The course operates under several important premises. First, within educational settings, technologies are not so much a curriculum as sets of tools to be put to use productively. The course works to establish what those productive uses might be.

Another premise is that productive use is influenced by three factors: context, audience, and activity. Problems presented for solution in the course are anchored in everyday classroom teaching and learning problems for which various technologies can be employed for, and with, learners, teachers, and communities. The goal is not to become an expert in technology, but to become more of an expert in teaching and learning.

Finally, the course operates under the assumption that teaching specific technologies will only enable the learner to accomplish a task in the short term. Technological advances continue to move forward at an exponential rate; present applications will inevitably be replaced by "new best ways." In moving the learner to a point of long-term usage and adoption, developing problem solving and cognitive strategies for the use of technology are highlighted.

Participants

The students enrolled in the course are diverse. Students taking the course represent various backgrounds, both in their professional interests as well as their technology expertise. The course not only attracts pre-service teachers; it also draws its population from a variety of disciplines across campus: accounting, communications, leisure services, and library science. The diversity of the classroom is also substantiated by the fact that it is a cross-level course, including both undergraduates and graduates.

Technology experience is just as variable as the professional interests of the students. Most students enter the course with a moderate level of technology experience; however, there are students that fall on the far ends of the experience continuum. A few students have never touched a computer and have typical fears of the technology; others have extensive experience, but need the credit in order to meet accreditation regulations (Technology for Teachers Surveys, 1994).

Goals/Objectives

The primary goal of the course is not to create experts in technology, but to assist the learners in increasing their levels of expertise in teaching and learning with the thoughtful application of technology. The problems presented in the course are anchored in classroom teaching and learning; problems for which various technologies can be employed for, and with, learners, teachers, and parents. Significant focus is given to the learner's individual growth as they work on various activities to solve common educational problems.

Specific objectives for the course include:

- To identify problems for which varied technologies offers useful alternatives for teachers, learners, and parents
- To plan and develop alternatives, featuring varied technologies for varied target audiences
- To develop a personal/professional growth plan for gaining facility in the uses of varied technologies
- To promote personal/professional growth by increasing both the range of technology alternatives and the ability to address problems with them

Components, Tools, and Techniques

There are several components to the course, both in terms of the tools and techniques used in the course and what is required from the learners. Each of these are discussed in the following section.

Tools. From the outset of the course, the learners are provided with tools to assist them in working in the learning environment. In addition to a syllabus, the learners receive a project documentation tool, a portfolio assessment methods tool, and a portfolio growth scale. A textbook is also used in the course: Lockard, Abrams, and Many's book, *Microcomputers for Twenty-First Century Educators* (1994, 3rd ed.). The text is not used in lock-step fashion; rather, it, like the other resources made available to the learner, is used as a supplement to what is occurring in the context of the classroom setting.

Accessing information. Establishing procedures for accessing information is a fundamental component of the course. "Accessing information" is defined in a broad sense. The network is used extensively to access the tools, as well as other documents that are loaded to clarify or explain technologies being discussed in class. The learners are encouraged to use electronic mail to communicate, both with each other and with us. Learners are also encouraged to seek information from each other, as well as other resources (such as the lab assistants, or their school media specialist) beyond the instructors.

Problem-centered, activity-based. Another technique used in the course is the introduction of technologies through problems. The course addresses problems and issues encountered in an educational context. Learners are encouraged to consider ways technology can be used to address the problems and issues. Throughout the semester, the students are presented with problems and issues to consider in relation to solving educational problems. While a focus is placed on solving those problems and issues with technological interventions, the learner is encouraged to expand their views.

Overtime, it is expected that the students in the course will begin to re-frame the problems and to consider alternative approaches and methods for defining the teaching-learning partnership. For example, the set of problems presented to the learners in a unit on telecommunications is: "How can my kids communicate with kids from other cultures or countries?; How can I find the latest information on a unit I will be teaching next week?; and How can parents find out information about the academic calendar or other school events?" This approach to viewing problems from multiple perspectives takes place with all of the technologies introduced in the course.

Demonstrations and practice. Following the establishment of a problem-centered context for learning, technologies are demonstrated to the class. This takes the form of "mind food:" it is a time in the class session when we present different ways to use the technologies. We demonstrate a variety of things that can be done, centered in different problems.

Learners next "walk-through" a hands-on process with us. This usually takes the form of a step-by-step demonstration. Practice time in the class is also provided. Several activities are demonstrated and practiced with each technology. This gives the learners the opportunity to experience a variety of ways to use the technology, thus helping to expand their views of how to incorporate the technology into their learning environments.

Requirements

Learners solve problems both as members of groups and/or as individuals. Three unit projects are being used: two occur throughout the semester; a final project is due at the end of the course. The unit projects are designed to integrate the technologies in a logical fashion. The first project integrates word processing and databases. The second project integrates telecommunications, desktops publishing and graphics.

The final unit covered in the course deals with emerging technologies, including videodisks, interactive video, and multimedia applications. The final project is geared toward the learners using these technologies. They are also allowed to create an integrated project reflecting all of the technologies covered throughout the semester.

All of the projects are turned in and graded in a portfolio format. We make use of the network and have a mechanism in place that enables the learners to turn in all of the work to us in electronic form. The electronic portfolios are evaluated after each project and feedback is provided to the learners.

Presentations of the work that is being completed occurs throughout the course. This includes demonstrations of completed work, as well as works in progress. Use of presentations also exposes the learners to presentation technologies, including LCD panels and demonstration programs like PowerPoint.

A final requirement of the learners is a reflection paper. This paper is due at the end of the course and is designed to encourage the learners to look back on their progress in the course, reflecting on what they did and where they would like to go next. The paper also addresses feedback on the course itself. Learners are encouraged to be critical and give suggestions for improvement.

Theory into Practice: Promises and Problems

Teaching technology in an OELE brings with it several promises and problems. Surveys from the three courses taught last year illustrate both the positives and negatives associated with OELEs -- at least from the perspective of the learner. Each of these, as well as our perspectives and unresolved issues, is discussed below.

Promises

Teaching technology in an OELE is a challenging, and in retrospect, very rewarding task. Not only did we see the classes as a whole develop in their technology skills, but significant strides in individual growth was encountered as well. Examples include: all learners reported an increase in the use of technologies; while over 50% of the participants said they started out feeling confused about the technology, all were in the high comfort zone by the end of the course; and the majority of the students reported that they liked to work individually and be assessed by individual growth (Technology for Teachers Surveys, 1994).

Direct statements from the learners can attest to the positive results of teaching technology in an OELE:

- I am leaving this class with not only a great deal of knowledge about computers and their possibilities than I had, I think I most importantly am leaving with confidence in myself when it comes to computers with[out] the intimidation that can hold anyone back from venturing and learning.
- My life's philosophy is if you can find the resource, then you can solve the problem. Working with computers is an ongoing process; everytime I sit down in front of one, I learn something different.
- I believe that the most valuable thing I learned from this class, however, was how to overcome my fear of making mistakes....I learned to trust myself a little bit more and to not feel as threatened by new technological development.
- I am not as intimidated by computers as I used to be and I believe I can do anything on the Mac now that I have a basic understanding....The main thing, though, is that not only can I do a lot more things with computers, but my fear of using computers is gone.
- I have learned to look around and ask around for what technological resources are available.... I assumed that if technology wasn't blatantly there in front of me, that it wasn't there.
- The most beneficial part of this call to me attitudinal. I am more enthusiastic about learning new technologies rather than fearing them. Another beneficial aspect of the course was the ability to tailor the technology applications to something relevant to us as individuals. Learning through experimentation and hands-on exposure proved very effective.

These statements from the learners in *Technology for Teachers* clearly reflect their enthusiasm for the course, the techniques and methodologies that were used, and the benefits the learners felt they received in learning in this environment. Getting to this point, however, was a long and often painful process, both for the learner and us. These factors are discussed next.

Problems and Issues

Perhaps the biggest problem facing all of the participants in the course was the time factor in relation to how long it took the learners and us to become comfortable. All of the participants in the course are accustomed to working and learning in a very directive and highly structured learning environment. *Technology for Teachers* is anything but directive and highly structured. In fact, one of the criticisms raised by the students is that it lacked detail and specifics. "One of the major problems I had with this course [was] that everything seems rushed and I was not comfortable with anything I turned in because of the pressure to complete my project on time" (Technology for Teachers Reflection Papers, 1994).

We also encountered experiences of disorientation and disorganization. Teaching in an OELE is quite a different experience from teaching in a more directive environment. The challenge for the instructor is one of how best to support and guide processes that are highly individualized without imposing unnecessary, potentially conflicting, external structures. Adapting to the demands of these learning environments, getting past the initial bump, is an issue, both for the learner and the instructor.

Closely tied to these feelings of discomfort over the learning environment is grade stress. This is well documented by one student when he states, "I think another reason it was tough [the course] is that the format is very free so a person doesn't know what qualifies as "A" work" (Technology for Teachers Reflection Papers, 1994). Grade stress had an effect on several aspects of the course, including resistance to the learning environment and identification of growth by the students -- their primary focus was on the "A," or lack thereof. Helping learners to overcome this stress, enabling them to move into an assessment realm of growth continues to be an issue to be resolved.

The variety of experience levels in the course is another issue that must be resolved. While several benefits were gained from having a variety of experience levels in the course, including sharing of ideas among peers and peer-tutoring, learners reported that varying levels of experience was distracting and that they worried about holding back the class or, in turn, being held back by the class (Technology for Teachers Surveys, 1994). One learner voiced her concern in the form of a question: "...wondering how you could separate the class from beginners, intermediate and expert.... How does one balance a class like this???" (Technology for Teachers Reflection Papers, 1994). We continue to seek the best answer to this query.

Technology for Teachers is a learning environment founded on the principles and assumptions of open-ended learning environments. Initial strides in creating a context for learning based on this theoretical foundation have proven successful; however, much work remains to be done to overcome the problems and issues associated with these environments. Continued work and research in these environments is critical if they are to continue to expand and grow. It is only though this continued work that educators can hope to reach the ultimate goal: creating learners rich in cognitive and problem-solving strategies.

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Title:

Instructional Design Theory and Scientific Content for Higher Education

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Introduction

Instructional designers are expected to familiarize themselves with content from a variety of content areas. But what happens when the content is highly technical, scientific content and the instructional designer has little or no background in the area? Can instructional designers lend their expertise to curriculum development efforts at the postsecondary level in subject areas such as engineering, biology, physics, or chemistry?

Computer-based instruction for higher education science instruction appears to be growing. More science texts in university bookstores are being packaged with accompanying software. The National Science Foundation has funded several curriculum development projects around the country, and many of them are computer-based instructional multimedia projects. The Worldwide Web also provides access to several computer-based instructional modules for the sciences.

Computer-based instruction could have considerable impact on improving the quality of science education. Simulations and interactive problems provide a means for students to explore scientific concepts and experiment without the expense or hazard of using actual materials. One of the most powerful strategies for science education is visualization, the process of animating concepts on the computer screen that are too small or large, or too abstract to be viewed in real life. Visualization provides a means to bridge the gap between abstract processes and students' prior knowledge. According to Hiroshi Higuchi & Eric F. Spina at Syracuse University (1993),

> "Many undergraduate students have difficulty applying the basic principles learned in engineering problems, such as those encountered in design courses and experimental analysis. One reason for this shortcoming is that undergraduates often do not achieve a thorough understanding of the underlying physical principles in basic engineering courses. If, however, students are exposed to a visual representation of the relevant principle, and are encouraged to manipulate and study the image, then a lasting understanding of the principle may be reached - one based more on physical intuition and a "feel" for the phenomenon than on memorization."

Many of the computer-based instructional software packages for science on the market today do not use the computer to its full potential, or use the medium inappropriately, for example, simulations designed for the computer when the use of actual materials in a lab would be more appropriate. It is important for software development efforts in the sciences to focus on the computer as a tool to explain, elaborate, clarify, and visualize aspects of a lesson that cannot be explained as well on paper, or through a lecture.

Thus, computer-based instruction for the sciences is an area that could benefit from the expertise of instructional designers. However, there are several issues concerning the collaboration between content experts and instructional designers:

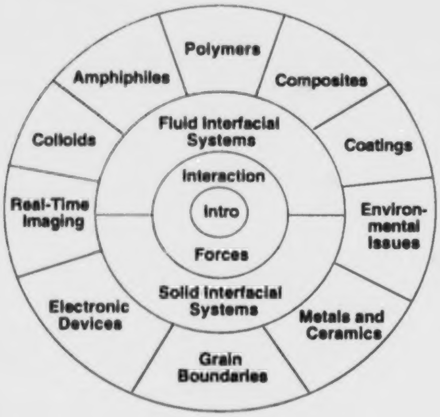
- Can instructional design theory be applied to higher education science content where the instructional designers don't understand the content?
- How familiar should an instructional designer become with the content?
- How can effective interactions be developed?
- How much time should the content expert be expected to put in?
- Who is a better source of content for creating interactive material -- the content expert or a novice in the field? Who is the most cost-effective source of information?
- Who could serve as an interface between the content expert and instructional designer?

This paper focuses on the instructional design process as it relates to the development of computer-based instruction for higher education. We examined (1) the instructional design process and lines of communication in our own computer-based project, (2) the instructional design process of personnel working on similar computer-based projects, and (3) existing computer-based software for higher education-level science content.

Center for Interfacial Engineering (CIE) Curriculum Development Project

Background

The Center for Interfacial Engineering (CIE) Curriculum Development Project began in June of 1993. Interfacial engineering is a new cross-disciplinary field that integrates research activities in aero, electrical, chemical, mechanical, and civil engineering, and chemistry. This curriculum development project is funded by the NSF and represents a partnership between engineers and educators to design and produce computer-based instructional modules. The modules have been used in conjunction with a textbook, Fundamentals of Interfacial Engineering.



Each module will have 5 tracks: (1) the main track provides the content, and is essentially a linear presentation of information. At certain points throughout the main track, the user may jump to other "tracks" to explore more in-depth information: (2) the theoretical track provides derivations of equations, (3) the experimental track provides simulations of experiments that explain how the information presented in the main track was obtained, (4) the application track provides real-world examples of the concepts in everyday life or industry, and (5) the interactive track provides problems and simulations that the user works through.

The development team currently consists of one primary and one secondary content expert, a full-time project manager/editor, a full-time instructional designer/graphic artist, and a half-time instructional designer/programmer. At the time of this writing, work on the main tracks is almost completed, and development of the theoretical and interactive tracks has just begun.

Development Process

When the project began, the content expert had completed the instructional analysis, and had developed storyboards that consisted of text and schematic figures drawn on transparency film. At the time, the development team consisted of one content expert, a full-time project manager/editor, one half-time instructional designer/graphic designer, and one half-time instructional designer/programmer. The initial development approach was to have a word processing specialist transcribe the storyboards into the authoring software, and then pass the module along to the project manager to edit the text and equations. Next, one of the instructional designers would program the module into the interface, and then give it to the other instructional designer to put in graphics and animations. As this system evolved, problems began to develop.

Content Experts and Instructional Designers

The working relationship between content experts and instructional designers does not have a reputation for being smooth, and there are many stereotypes about each other's competence. Stephen Lower, a professor of Chemistry at Simon Fraser University, in his paper, How to Make Computer-Assisted Instruction Fail (February, 1993), states

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> "The lessons themselves should have been designed by Education specialists, who are more likely to employ well-established response-reinforcement techniques. For example, Statement: "Fire engines are red." Question: "What color are fire engines?" B. F. Skinner used this technique with great success to train pigeons, who are evidently immune to boredom. This will turn away all but your most unimaginative drudges."

The instructional designers on the CIE project had heard that this attitude was common in the field. And initially this appeared to be true, because the content expert did not believe that instructional design theory was applicable at the postsecondary level, since most research on the subject dealt with instruction at the K-12 level.

As the instructional designers and content experts continued to discuss the development of the content, it became apparent that they were discussing the same instructional design principles, but using different terminology. For example, the instructional designers would talk about "test items" and "evaluation" and the content expert would refer to these concepts as "interactions." Consensus about instructional approaches improved once the team developed a common vocabulary.

Familiarity with the Content

Initially, the instructional designers believed that they were expected to become completely immersed in the content. The content expert knew that they would never become completely competent with the material, but still had the expectation that the designers would be able to take the content, and, from a brief explanation, be able to transform the storyboards into workable modules.

As the content expert and instructional designers worked together, they eventually realized that the instructional designers would never understand the content entirely, but could understand the structure of, or relationships within, the content. For example, the instructional designers could never understand the full nature of *inverted micelles*, but they could recognize that they represent one type of amphiphilic aggregate. As a result, the development process became a more collaborative process, and the linear development approach was replaced by an iterative one.

As the instructional designers spent more time working with the content, they became more knowledgeable, and better able to see relationships. Also, they became more familiar with the conventions that the content expert used in the storyboards. For example, when the content expert drew a box with an arrow, it represented a beaker, and an enlarged view of what was happening in the beaker on a molecular level.

Overlap of Roles

Developing a module requires each team member to have some familiarity with programming, graphics, editing, etc. Problems arose when team members moved into another's area of expertise. For example, the editor had to re-word some incorrect, elaborate text passages that had been written by other team members, the programmer had to rewrite unnecessarily complicated code, and the graphic artist had to recreate inaccurate graphics and animations.

This problem has not been completely solved, but it has been minimized. In most instances, the text is usually changed only with the editor's approval, interactions are worked out on paper first and the content expert and programmer work together to put them onto the computer, and graphics are either rendered as schematically as possible.

Time Demands

Module development came to a halt when there were unanswered questions about the content. The development staff had to wait (sometimes for weeks) until the content expert could find the time to explain. An organizational expert on staff at the Center was asked to examine the team's process and determine ways to make it more efficient. After talking with the team and drawing a graphic representation of the process, he calculated that it would take over 20 years to complete the project, because each iteration involved the content expert.

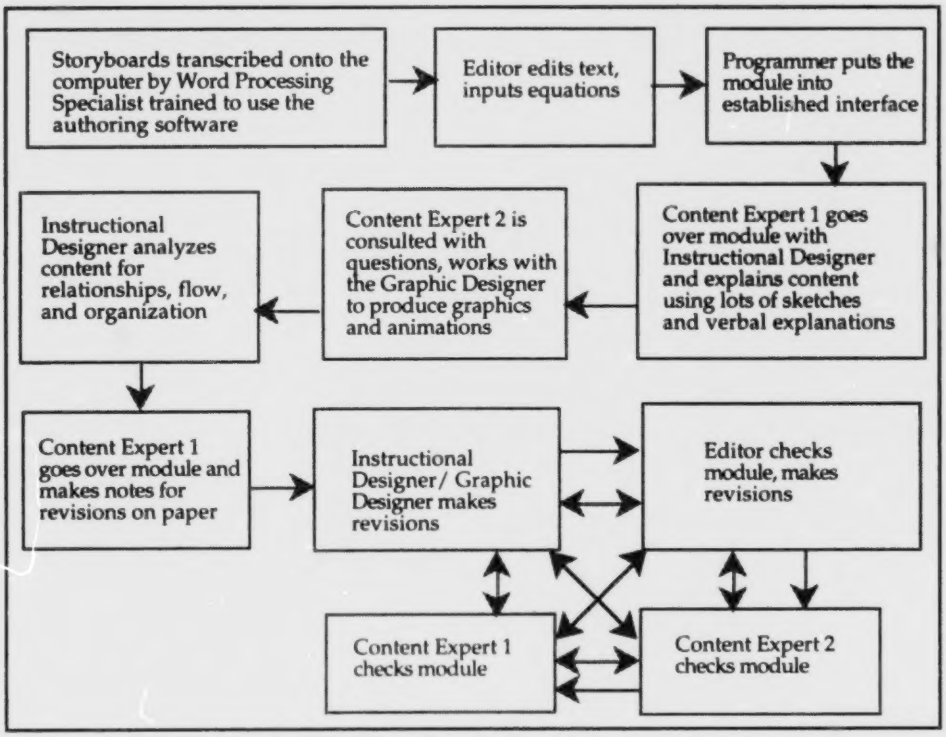
To solve this problem, a retired professor of chemistry was contracted part-time to serve as a secondary content expert. This solution had the greatest impact on the project. The professor was able to answer questions, explain processes, create charts and graphs, and edit content for accuracy. He provided a crucial link in the development process, as he had the necessary scientific background and the time to devote to the project.

Content Accuracy

The instructional designer/graphic designer would experiment with different ways of presenting the content. Most of the time the approaches were successful, and the rest of the team supported her creative license. However, on a few occasions, the content was altered to the point of inaccuracy, much to the distress of the project manager. The project manager asked the instructional designer to check with the content expert before changing anything, but the instructional designer felt that doing so would be excessively inhibiting.

After discussing the problem with the project manager, they agreed that the instructional designer could continue to experiment, but on highly technical content or on sections containing many equations, the instructional designer would work on a copy of that section, saving the original approach. When the project manager comes to that section, he can consult with the secondary content expert and make the final decision about which part to retain.

After addressing these problems, the development process evolved to the following:


Storyboards transcribed onto the computer by Word Processing Specialist trained to use the authoring software
Editor edits text, inputs equations
Programmer puts the module into established interface
Content Expert 1 goes over module with Instructional Designer and explains content using lots of sketches and verbal explanations
Content Expert 2 is consulted with questions, works with the Graphic Designer to produce graphics and animations
Instructional Designer analyzes content for relationships, flow, and organization
Content Expert 1 goes over module and makes notes for revisions on paper
Instructional Designer/ Graphic Designer makes revisions
Editor checks module, makes revisions
Content Expert 1 checks module
Content Expert 2 checks module

Summary

For curriculum development projects in the sciences at the postsecondary level in which the instructional designers do not have a science background, it is important to clarify how much faith the content expert has in the instructional designer in terms of structuring content, and what their expectations are. It is also important for content experts and instructional designers to speak the same language with regards to the design of the instruction.

Each lesson must go through several iterations among team members, whose roles should be defined as clearly as possible. These iterations between the team members ensures accuracy of content, clarity of organization, appropriate use of the computer's capabilities, and ease of navigation. If the content expert does not have the time to complete several iterations, a secondary content expert, such as another professor or a graduate student, may be able to bridge the gap.

Other CBI Development Efforts

Survey

In order to learn about the design process of other computer-based development efforts in the sciences, we sent a survey to other NSF grant recipients who were working on similar projects at the postsecondary level. We also sent the survey to an authoring discussion group on the Internet. We were interested in qualitative information on how they approach development, the roles of team members, whether or not team members have a science background, and, if not, how they communicate.

Results

The majority of respondents were developing software to supplement a specific course, textbook, or lecture. They were initiated by college faculty who were the content experts for their respective projects. Most of their projects had been going on from 1 to 4 years. The scope of the projects was affected by the size and structure of the team. Projects that were developed by individuals were narrower in scope, dealing with specific lesson segments to supplement class lectures, and generally consisting of practice problems for the users. Team projects dealt with large units of instruction, sometimes at the curriculum level.

In order to examine the design process and the lines of communication in team projects, we divided the surveys into three groups: (1) content experts who work mostly on their own, (2) content experts who work with a team in which all members have a science background, and (3) content experts who work with a team in which not all members have a science background.

Development Approach

It seemed that the division of labor in a project where all members had a science background did not always take advantage of specialized skills. In some projects, the entire module was divided into lesson segments, and each member would work on a particular segment, doing all the writing, programming and graphics. For teams in which not all members had a science background, the development approach was more collaborative, although there was considerable overlap of roles. In the majority of projects where not all members had a science background, the content experts provided the initial storyboards and the subsequent development was done by the other team members, and the content expert continued to be consulted throughout the development.

Roles

When asked what roles were played by the team members, rarely was the term instructional designer used. The most commonly stated roles were content expert, graphic designer, and programmer. Most people filled more than one role, and it seemed that in particular programmers did a lot of the instructional design work, such as writing feedback, storyboarding content, etc.

Communication

As expected, when all team members had a science background, communication was not a problem. In teams where not all members have a science background, we were expecting respondents to cite communication as a significant constraint, but that was not the case. Apparently, team members have overcome communication barriers by using strategies that helped bridge the gap between what the content expert is trying to communicate and what the other team members understand. Most of them state that they use a lot of sketching and verbal explanations, and back this up with frequent checking and clarification of material by the content expert. In several surveys the respondents indicated that an added benefit to this approach was that, in the process of explaining things to the other team members, the content members learned to be more focused, and to make instruction more explicit.

Constraints

The most commonly listed constraints were financial and time. The majority of professors who responded stated that it was difficult to devote enough time to the development of computer-based instructional projects because of other demands, and because professors may not receive publication credit for software.

Summary

Many teams are working together successfully to design and develop science software, despite the fact that not all team members have a science background. Survey results indicate that the communication gap is not seen as a constraint. The use of verbal explanations and sketching helps to bridge the gap. In addition, content experts indicated that discussions with other nonscience team members helped them to improve their teaching strategies in the classroom. Results indicate that the role of the instructional designer in technical and nontechnical content areas is different, especially in the Analysis and Design phases (see Table 1 for a comparison).

Table 1. The Role of the Instructional Designer in Highly Technical vs Nontechnical Content Areas (assuming the ID has no prior knowledge with the content)

	Highly Technical Content Areas	Nontechnical Content Areas
Analysis	The content expert completes the needs assessment, identifies the instructional problem, and does the task analysis. The instructional designer's role is to ask relevant questions to guide the content expert *(for example, "What is the gap between what students should know and what they actually know? What are the goals, learner characteristics?" etc.).*	The instructional designer completes the needs assessment, problem identification, and does the task analysis.
Design	The content expert writes objectives, develops test items, and plans the instruction. The role of the instructional designer is to provide examples of instructional strategies that the content expert might adapt, and to ask questions that clarify the objectives, the content structure, the kind of learning that's supposed to take place, the kind of activities that will best facilitate learning, the graphics that go with the lesson, etc. *(for example, "How would you approach a lesson/concept? Problem first or description first? What is a good example of this relationship? Should the lesson branch out at this stage? If yes, where to?").*	The instructional designer writes objectives, develops test items, and plans the instruction. The content expert serves as consultant, and answers specific content-related and structural questions, clarifies terms, jargon, etc.

Table 1 (continued). The Role of the Instructional Designer in Highly Technical vs Nontechnical Content Areas (assuming the ID has no prior knowledge with the content)

Development	The content expert generates storyboards that establish the sequence of instructional events. The role of the instructional designer is to gain as much familiarity with the content as possible, to try to recognize relationships in the content, and to make sure that there is flow and consistency. The instructional designer and the content expert work together to make decisions about media.	The instructional designer writes the content, develops storyboards, develops a prototype, and goes back to the content expert for feedback.
Implementation	The instructional designer prepares necessary documentation and oversees installation.	The instructional designer prepares necessary documentation and oversees installation.
Evaluation	The instructional designer evaluates the materials based on the objectives and test items generated by the content expert. The content expert and instructional designer work together to make revisions.	The instructional designer evaluates the materials and makes necessary revisions. The content expert serves as a consultant.

Existing Science Software

We were interested in finding out whether or not existing science software for higher education demonstrated evidence of effective instructional design: (1) orienting information, (2) screen design, and (3) navigation, and (4) effective use of the media. We were not able to evaluate the actual content, since the software packages dealt with a wide variety of highly technical content areas. The software that we reviewed included a sample of computer-based modules that are currently packaged with science textbooks at the University of Minnesota bookstore, and science software packages that we obtained by word of mouth.

Results

All of the software that we looked at was intended to be used as a supplement to a textbook or lecture, in varying degrees. Some of the software consisted of complete instructional modules. Most of the software that was packaged with a textbook simply provided practice problems for particular segments of a lesson or course.

Orienting information

Many of the applications that we looked at consisted of a main menu that listed different sections that could be accessed by clicking on them with the mouse. Across all of the software that we reviewed, there were no goals or performance objectives, and very little feedback. The feedback generally consisted of "correct" or "incorrect" with no elaboration. The format generally consisted of an instructional unit followed by practice questions. The practice questions were generally multiple choice, and the majority of the questions required the user to input a correct answer before continuing. Some of the practice questions asked the user to input data, and these also required a correct number to be input before moving on. None of the modules contained an on-line glossary, and only one module had a help button. None of the modules provided page numbers, or any means to let the user know how much they had completed or how much was left.

Screen design

The software ranged from those that used effective, simple graphics and animations to those that were purely text-based. The software that was mainly text-based appeared to be better suited for paper-based presentation. For the software that incorporated graphics and animations, the font used was easy to read, but the on-screen text generally appeared to be excessive. In general, elements on the screen (text, graphics, navigational buttons) appeared in different locations on the screen in different sections of the lesson.

Navigation

The software ranged from that which presented the information in a linear fashion to software that allowed the user to jump to different sections, or to different segments entirely, such as problem-solving or experiments. However, across all of these different approaches, the majority did not have a means for the user to back up. In the software that provided a main menu, the users always had the option to jump back to the main menu, but not to back up within the section.

Effective use of the media

Aside from the purely text-based approaches, the majority of software packages that we reviewed took advantage of the computer's ability to visually demonstrate abstract concepts. The graphics and animations were simple, yet effectively demonstrated the concepts. Most of the interactivity of these modules was navigational, where the user selected the section of the lesson that they wanted to access. Some of the modules had simple interactions in which the user input data and clicked a button to see the graphic result. A few of the modules incorporated simulations in which the user could manipulate data in the context of solving a larger problem. Most of the interactivity was not incorporated into the instruction, but existed as a separate section.

Summary

There seemed to be a general lack of instructional design components in the software packages that we reviewed. Each package had at least one component of effective instructional design, but no single package demonstrated all. For example, one software package had good graphics and animation but didn't have any feedback, another package had very effective help buttons but didn't allow the user to move backward. Several of the applications were entirely text-based and would be better suited for paper presentation. All of the software lacked goals and objectives. Many of the modules had practice questions, but there was not much feedback and it generally consisted of "incorrect" and "correct," and most questions required a correct answer before continuing. Very few of the modules we looked at were interactive, and most of the interactions consisted of the user inputting data and pushing a button to see a graphic result, without showing the process.

Conclusion

Through visualization, simulations, and interactions, the computer has great potential for improving science education at the postsecondary level. Many currently available software packages on the market today do not seem to take advantage of the computer's capabilities, thus the application of instructional design principles to future computer-based development efforts in the sciences could help to produce more instructionally sound software.

It is possible for instructional design theory to be applied to higher education science content. The primary difference between technical and nontechnical instructional design approaches is that in technical content areas, the instructional designer's role is to guide the content expert through the analysis and design stages, and there are more iterations with the content expert throughout the entire development process.

It is not necessary for instructional designers to become completely immersed in the content, but it is important for them to become as knowledgeable as possible in order to ask relevant and guiding questions. It is important to develop common vocabulary about approaches to instructional principles. The communication process between content experts and instructional designers can be facilitated through the use of verbal explanations and sketches, and other professors or graduate students may help to bridge the gap between the knowledge of content experts and the backgrounds of instructional designers.

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Title:

Digitized Speech as Feedback on Cognitive Aspects of Psychomotor Performance during Computer-Based Instruction

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Introdution

The importance of feedback to facilitate learning has long been acknowledged (Kulhavy, 1977; Mory, 1992; Schimmel, 1986; Bangert-Drowns et al, 1991). Appropriate feedback confirms the learner's expectancy, directs attention to relevant factors, and stimulates recall of relevant skills and knowledge (Gagne, 1985). Computer-based instruction (CBI) opens new avenues for increasing the variety of possible feedback strategies that a teacher may employ to optimize learner performance. However, there is little empirical research to indicate that educational gains can be achieved by simply incorporating speech as feedback on cognitive aspects of psychomotor domain.

The effectiveness and impact of speech in such roles as the delivery of content, feedback and motivation in classroom instruction are well documented (Brophy, 1981, 1986; Sales & Johnston, 1993). Sanders, Benbasset and Smith (1976), for example, argue that for speech to add significantly to learning, it must not "merely take the place of a hard-copy manual or of printed text on a computer terminal." Saloman (1979, 1985) also argues that research on the effectiveness of media must look at the most essential characteristics of symbol systems being utilized. In software that utilizes digitized speech, Brophy (1986) indicates that these essential characteristics are the familiarity of the source, the nature of the learners relationship with the source, and the attitude communicated through tones and inflections in feedback to the learner.

Feedback effectiveness is influenced by the nature of the learning task and student ability. For example, KCR was most effective than AUC feedback for low ability students (Dick & Latta , 1970). In a recent studies, Clariana and Smith (1989, 1991) suggested that higher ability students benefit from the additional information provided by elaborative feedback. Furthermore, low ability students performed poorly with elaborative feedback. Speech can be a critical feedback component of instruction. It appears to be particularly valuable as a means of commutation between the teacher and the learner. To date, however, very little research has been conducted which looks at the effects of digitized feedback under different learner characteristics (e.g., high- or low-prior knowledge) on cognitive aspects of psychomotor performance.

The purpose of this study was to investigated the effects of digitized feedback and ability on the achievement of college students during computer-based instruction. The achievement of high and low-prior knowledge students was compared among different types of feedback treatments.

Method

Subjects

A sample of 68 university students from four sections of beginning tennis classes at the Chung Cheng University participated in the study. Student's preexisting tennis knowledge was tested to categorize them into high and low prior knowledge groups. High prior knowledge students were defined as those with pretest scores above the 55th percentile, while low prior knowledge students were defined as those with scores below the 45th percentile. In order to control for the ability of learning in the study, the middle 10% of the students (those falling between 45th and 55th percentile) were not included.

Materials

CBI Lesson Content. The computer-based instructional unit used in this study were an interactive video lesson on cognitive area of tennis skill performance. The interactive video instructional module employed was designed to help the beginners build up there basic foundation in tennis skills. By carefully selecting the Beginning of Tennis instructional video program, the lesson included four sections: a) The Grip; b) Correct swing technique; c) Approach shots; and d) Terminology and Rules. During the lesson, students received immediate feedback in specific skill areas as well as valuable experience in working with questions and problems posed in the style of the computer-delivered post test. All versions of the lesson provided the same information, examples, and practice on the concepts of learning. The average of three versions required 50 minutes for the subject to complete the interactive tutorial lesson.

Retention test. Two weeks later, subjects take a 40-item test in a paper-and-pencil format. In order to maintain reliability and consistency, subjects would not be informed of the retention test until it was administered. The Spearman-Brown formula was used to calculate the split-half reliability of both question sets. The reliability of the lesson immediate posttest questions was r=0.70.

Attitude Questionnaire. Following the lesson, students responded to a Likert-type questionnaire developed by author. This instrument contained ten items. It was designed to collect data on the usefulness, quality, weaknesses, and overall feeling that the students had for the interactive video-delivered instruction. Subjects responded to both positively and negatively worded statements by marking their opinions on a scale from 1 (strongly agree) to 5 (Strong disagree). The Cronbach's Coefficient Alpha reliability for the questionnaire was .92. An typical item on the questionnaire was, "The program was easy to use".

Experimental Procedures

Based on subjects' prior knowledge test scores (preexisting knowledge of tennis), students were randomly assigned to a computer and completed one of three treatment version: spoken audio only-KOR, knowledge of the correct response -KCR(voice with text), and elaboration feedback -EF(voice with text, visual and animation). To resolve logistical constraints, the study was implemented during a four-week period. All students received two days of computer-based instruction with an interactive video on the four sections of beginning tennis program. Each student spent about 45-55 minutes each day to finish two section content. Two weeks after the above activities, all subjects were individually administered the retention test(paper-and pencil). Seven absentees completed the pretest one week late. However, several other students could not complete the posttest and retention test. The total of fifty-five subjects completed the study.

Design and Data Analysis

The study employed a 3 X 2 factorial design. The first factor was feedback with three levels: spoken audio only-KOR, knowledge of correct response-KCR(voice with text) and elaborative feedback-EF(voice with text, and visual) and second was ability (High versus Low-prior knowledge). In analyzing data, ANOVAs were conducted on each set of variables. The dependent variables of the study were achievement on the delayed retention test and attitude measure scores. Calculations were made using the Statistical Package for the Social Sciences (SPSS) 4.0 for the Macintosh, (© 1990, SPSS Inc.). All tests of significance adopted an alpha level of .05, unless otherwise indicated.

Results

Achievement

Achievement was operationalized as an individual's score on the retention posttest. Means and standard deviations of student performance on retention test are given in Table 1. The results of the ANOVA showed significant main effects for Feedback, F(2,49) of 6.43, p=.003. for Ability, F(1,49) of 4.70, p=.035. High ability students (M = 31.53) performed better than low ability students (M = 29.69). The feedback main effect was further analyzed via Scheffe follow-up comparisons of the three overall treatment means. Results indicated the elaborative feedback (EF) conditions (M = 32.50) was higher than the KOR and KCR feedback conditions (M = 29.28 and M = 31.11). However, there were no significant differences between KOR(spoken only) and KCR feedback(spoken with text) condition. The interaction between level of ability and type of feedback was not significant.

Table 1.
Means and Standard Deviations for Retention Test Scores.

		FEEDBACK			
		KOR	KCR	EF	Total
Ability					
High	**Mean**	29.25	33.00	32.20	31.53
	SD	3.41	2.88	2.25	3.15
	N	8	8	10	26
Low	**Mean**	29.30	29.11	32.80	29.69
	SD	3.95	2.80	2.59	3.14
	N	10	9	10	29
Combined					
	Mean	29.28	31.11	32.50	30.61
	SD	3.68	2.84	2.42	3.15
	N	18	17	20	55

Attitude Measure

Means and standard deviations for attitude scores are presented in Table 2. Generally speaking, no matter which ability levels and what treatment conditions the subjects were categorized, they rated the instructional program closer to the positive direction. The average rating based on all of the subjects across all questions was 3.32 (SD=.53). The mean attitude score for low ability students was higher (M = 3.34) than the mean attitude score for high ability students (M = 3.28). Similarity, the KOR feedback condition (M = 3.48) resulted in highest mean attitude score than the other two feedback conditions (KCR, M = 3.34; EF, M = 3.14, respectively).

Table 2.
Means and Standard Deviations for Attitude Scores.

		FEEDBACK			
		KOR	KCR	EF	Total
Ability					
High	**Mean**	3.43	3.60	2.92	3.28
	SD	.68	.57	.34	.53
	N	8	8	10	26
Low	**Mean**	3.54	3.11	3.36	3.34
	SD	.55	.45	.34	.45
	N	10	9	10	29
Combined					
	Mean	3.48	3.34	3.14	3.32
	SD	.59	.55	.39	.53
	N	18	17	20	55

Discussion

The purpose of this study was to investigate the effect of different types of computer-delivered feedback at different learner ability levels in cognitive areas of psychomotor skill performance. Students' attitudes toward computer-based instruction with an interactive video were also assessed. At the end of the lesson, the students completed an attitude questionnaire and a 14-day retention test.

As suggested from the results, the anticipated interaction between ability and feedback was not confirmed. The study revealed that the elaborative feedback was most beneficial for cognitive areas of psychomotor skill learning. One plausible explanation for the results obtained is that the elaborative feedback facilitated the acquisition of skill by viewing an ideal/prototypical performance of interactive videodisc-delivered instruction. As Schwier (1987) suggested, the marrying of computer instruction and television provides a potentially powerful training medium. Instructional video may also reinforce learning in understanding the role of observation/perception in the acquisition of motor skills.

The results of the study revealed that no matter which ability levels or treatment conditions the subjects were categorized, they rated the instructional program closer to the positive direction. The difference is particularly noticeable for low ability students in the KOR feedback group which recorded the highest attitude scores of the groups. On the other hand, high ability students in the elaborative feedback group reported the lowest attitude scores. Perhaps, low-ability students feel more comfortable and confident after simple feedback responses, while high-ability students received too much information which may have interfered with learning.

Feedback is an essential construct for many theories of learning and instruction. Frequent and consistent use of feedback is also strongly promoted in today's theoretical development, instructional practice, and educational psychology. However, while the benefits of feedback in general might be taken for granted, uncertainty still exists as to how to select and optimize uses of different forms of feedback depending on myriad psychosocial characteristics of students and the learning situation. Further research is needed to clarify this uncertainty and provide the learner with the most effective and efficient type of learning environment.

Additional research is needed to determine whether higher cognitive tasks may impact the learner's prior knowledge to process feedback effectively. Higher order cognitive tasks involve a more complex variety of skills, thus usually making learner more difficult to attain. The use of simple feedback may not be enough to guide the student through the complex components of such a task. Therefore, the use of extra-instructional feedback should be examined further. "That is, containing additional information from outside the immediate lesson environment "(e.g., new examples, analogies, or new information to clarify meaning). Also, of particular relevance for the current study, motor skill acquisition, in which changes in bodily movements are required for mastery, is an important domain as yet largely unexamined in the literature on feedback in technology-assisted instruction.

Additionally, emerging interactive technologies are gradually taking an important role in schools, educators are still facing a serious dilemma. They are either to find more effective ways of using these technologies in the classroom or to limit the access by large groups of students. Researchers should also investigate the nature and strategies of promotive interaction within group learning.

Finally, researchers should examine the effects of varieties of feedback in varied new and emerging technological instructional environments. Environments are becoming increasingly available which offers an increasing range of feedback types (for example digital images, high-speed animation, video, audio, and speech). Also, technologies utilizing digitized full-motion video and virtual reality will be widely available as instructional environments in the near future, bringing with them opportunities for multi-sensory forms of feedback. Understanding how to match learners with feedback appropriate to achieve desired learning outcomes in these sophisticated instructional technology systems will certainly deserve increasing attention in the near future.

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Title:

Effects of Types of Feedback on Achievement and Attitudes during Computer-Based Cooperative Condition

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Introduction

A principal concern of instructional technologists is the development of generalizable mechanisms which enhance the acquisition of specific learning outcomes that are compatible with both the learner and learning environment. While research concerning feedback and cooperative learning are prevalent in educational literature, there has been little systematic research to support whether various types of feedback in cooperative learning situations can affect student performance outcomes and attitudes. Computer-based instruction (CBI) opens new avenues for increasing the variety of possible feedback strategies that a teacher may employ to optimize learner performance, but it is not clear which type of feedback is most beneficial under different learner characteristics (e.g., high- or low-prior knowledge) during computer-based cooperative condition.

Various types of feedback can be grouped according to their characteristics and on their functions (Dempsey & Sales, 1993). No feedback (NF) allows the learners to progress through the instructional sequence without receiving any external indication of the degree to which they understand the content. Knowledge of correct response feedback (KCR) includes a statement that a response is "right" or "wrong" and a comment identifying the correct response. Elaborative feedback consists of all substantive information contained in the feedback message. It appears that elaborative feedback seems to encourage the construction of a richer network of pathways to the desired information.

Feedback effectiveness is influenced by the nature of the learning task and student ability. For example, KCR was most effective than AUC feedback for low ability students (Dick & Latta , 1970). In a recent studies, Clariana and Smith (1989, 1991) suggested that higher ability students benefit from the additional information provided by elaborative feedback. Furthermore, low ability students performed poorly with elaborative feedback.

Substantial evidence exists to suggest that cooperative learning structures can promote positive relationships and efforts to achieve that are key to maximizing the potential of the technology (Hooper & Hannafin, 1988, 1991; Johnson & Johnson, 1989). Cooperative learning also appears to foster higher level cognitive reasoning, increased achievement and retention, and higher level conceptual understanding (Johnson & Johnson, 1989). Students who explain lesson material to a partner appear to generate elaborative connections between new and existing information, resulting in deeper processing of lesson content (Webb, 1982). To date, however, very little research has been conducted which looks at the effects of feedback under different learner characteristics (e.g., high- or low-prior knowledge) during computer-based cooperative environment.

The purpose of the study was to examine possible interactions among different types of computer-delivered feedback on cognitive learning outcomes and attitudes during computer-based cooperative condition. The achievement of high and low-prior knowledge students was compared among different types of feedback treatments.

Method

Subjects

Subjects were 120 university students enrolled in six sections of beginning weight training at the University of Minnesota. Students were classified as high-or low-prior knowledge according to performance on the pretest of pre-existing knowledge of weight training. The students were randomly assigned within prior-knowledge groups to one of three types of feedback treatments. High prior knowledge students were defined as those with pretest scores above the 55th percentile, while low prior knowledge students were defined as those with scores below the 45th percentile. For the purpose of creating heterogeneous pairs of students for cooperative learning and as a way of reducing the classification error, the middle 10% of the students (those falling between 45th and 55th percentile) were not included in data analysis.

Materials

The CBI lesson. The computer-based instructional module used in the study was designed to help the beginners build their basic cognitive foundation in weight training. During the lesson, students received immediate feedback in specific skill areas and questions posed in the style of the computer-delivered practice test. This unit is designed for self-instruction and group learning. The unit can be integrated with the basic level of curriculum presented in typical weight training classes and used in conjunction with already existing materials and standard texts such as Hatfield and Krotee' Personalized Weight Training (1984).

The content presented in the module consists of four sections: 1) Terminology related to resistance training. 2) Safety in the weight room. 3) Warm up and cool down protocols. 4) Correct lifting technique. In pilot studies, the instructional lesson was reviewed and revised by two content experts and four weight training instructors. The instructional lesson was formatively evaluated using students of the target group, and was revised into its final form. In addition, data from the pilot study indicated its effectiveness in helping students learn concepts. That is, students who completed the module learned the material to a higher degree of competency than did those who did not go through the unit.

Retention test. Two weeks after completing the computer-based instruction, all students received a paper-and-pencil retention test. This multiple-choice test contained 40-items , based on knowledge and application of learning outcomes to test students' factual recall and conceptual understanding of the lesson. These items were previously chosen from the pilot study involving the same content and a similar population. Cronbach's alpha method was used to calculate the reliability of the retention test, and was found to have a value of .82. The mean of the 40 item retention test was 28.2 with a standard deviation of 4.50.

Attitude questionnaire. Following the lesson, students responded to a Likert-type questionnaire developed by Simsek & Tsai (1992). This instrument was designed to measure students' reactions to cooperative learning. It included 27 items containing a 5 point scale ranging from "Strongly Agree" to " Strongly Disagree". The items were equally divided among three categories: attitudes toward delivery system, attitudes toward subject matter, and attitudes toward group work.

The Coefficient alpha reliability for the questionnaire was reported to be .91 (Simsek & Tsai, 1992). Although those authors used the questionnaire with sixth grade students, the current study still found a high reliability (.86) for the instrument, even though the subjects here were adults. The purpose of the scale assessing attitudes of students was to determine students' liking to the delivery system, the subject matter, and of working with a partner. An example item for each category was: "I enjoyed working with the computer" (delivery system); "I would like to learn more about weight training" (subject matter); and "I feel more comfortable working in a small group than working alone" (group work).

Procedures

The study was implemented during a six-week period. The pretest was administered during the first week. The basic cooperative skills training was completed by all students and occurred during the second week. During the third week, each student completed two computer-based instructional units. Each student spent about 40 to 50 minutes each day to finish two units of content. During the fourth and fifth weeks, nothing related to the study happened for the students. The retention test was delivered in the sixth week of the study.

Subjects were assigned to treatments using stratified-random sampling. Initially, high- and low-prior knowledge students were randomly assigned to paired. Next, within each class, subjects in the paired treatment were ranked within each ability group. Partners were assigned by combining students with identical ranks. The most able high- and low-prior knowledge students were paired, as were the second most able and so on. Thus, equivalent heterogeneity among group members was established. Each group contained two subjects.

The study was conducted in the weight room of the kinesiology department. Sixteen Macintosh SE computers were set up before each class. Specific directions for implementing individual versus cooperative strategies were provided for each condition. Subjects were assigned to a computer and completed one of three types of feedback version of the CBI lesson. Upon completion of the lesson, each subject individually completed the attitude questionnaire. Two weeks after the above activities, all subjects were individually administered the delayed retention test.

The basic cooperative skills training was adapted from procedures recommended by Johnson and Johnson (1984). Students were presented with a 50 minute instructional module development by the researcher for use with the four weight training instructors intended to guide students toward better use of cooperative behaviors. Two activities were given to the cooperative learning groups' instructors to help reinforce those behaviors students need in order to work cooperatively.

Design and Data Analysis

The study employed a 3 x 2 factorial design. The first factor was Types of feedback with three levels (no feedback-NF, knowledge of correct response-KCR, and elaborative feedback-EF), and the second was Ability had two levels (high and low-prior knowledge). In analyzing data, two-way ANOVA was used. Dependent variables of the study were achievement on the retention posttest, and attitudes toward computer-based instruction, weight training, and learning in pairs. The alpha level was set at .05, unless otherwise indicated.

Results

Achievement

Achievement was operationalized as an individual's score on the retention posttest. Mean scores and standard deviations for retention posttest scores can be found in Table 1. Results of the ANOVA showed significant main effects for feedback type $F(2, 114) = 5.95$, $p < .01$, and for ability $F(1, 114).= 17.57$, $p < .001$. A two-way interaction was found between Feedback and Ability $F(1, 114).= 13.99$, $p < .001$. The feedback main effect was further analyzed via Scheffe follow-up comparisons of the three overall treatment means. Results indicated the EF mean ($M= 33.00$) and the KCR mean ($M= 31.63$) were both significantly higher than NF mean ($M= 27.00$). However, there were no significant differences between KCR and EF conditions. A simple inspection of the means shows students in the high-prior knowledge treatment ($M= 31.95$) outperforming those in the low-prior knowledge treatment ($M= 29.13$).

The significant interaction between Feedback and Ability was further analyzed by comparing the six feedback means, using a Scheffe's procedure to analyze the 15 possible pair-wise comparisons. The results of this analysis are shown in Table 3. Findings, although not significant, indicated that for low-prior knowledge students, the KCR condition mean was higher than that for the elaborative feedback (EF) condition. However, for high-prior knowledge students, the elaborative feedback (EF) condition mean was a significantly higher than the KCR condition mean. This proved to be significant level. That is, high-prior knowledge students performed better under the EF feedback condition. However, the assumption that KCR feedback condition is better than EF feedback condition for low-prior knowledge students was not confirmed. The interaction is graphically displayed in Figure 1.

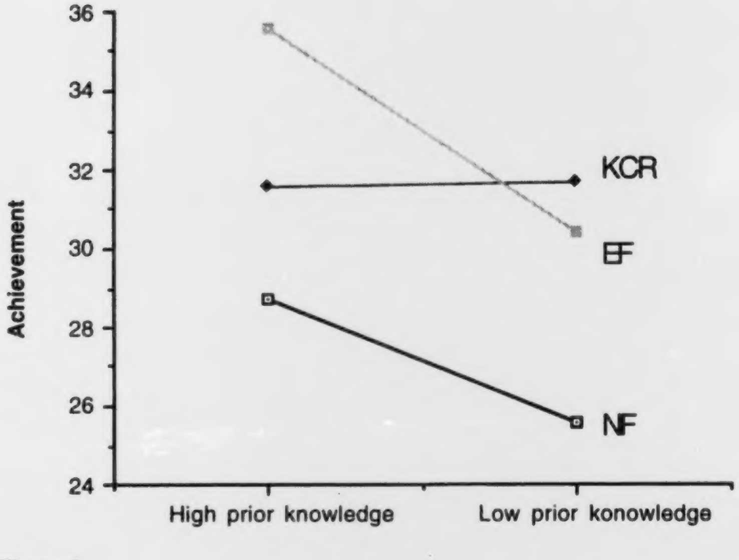

Figure 1.
Graph of the Interaction of Feedback and Ability (prior knowledge) by Retention Posttest.

Table 1.
Means and Standard Deviations for Retention posttest Scores.

			FEEDBACK		
		NF	KCR	EF	Total
High	M	28.75	31.55	35.55	31.95
	SD	2.05	1.86	1.79	3.43
	n	20	20	20	60
Low	M	25.25	31.70	30.45	29.13
	SD	3.09	2.66	1.77	3.84
	n	20	20	20	60
Combined					
	M	27.00	31.63	33.00	30.54
	SD	2.57	2.26	1.78	3.64
	n	40	40	40	120

Attitudes

Student attitudes toward the delivery system, subject matter, and group work were measured with the attitude questionnaire. Attitudinal data for 108 out of the original 120 subjects were included in the analyses of the results because scores on one or more measures were unavailable for the remaining 12 subjects (For random reasons: illness, transportation problem, etc.). Means and standard deviations for overall attitude scores are contained in Table 2.

Table 2.
Means and Standard Deviations for Attitude Scores.

			FEEDBACK		
		NF	KCR	EF	Total
Cooperative					
High	M	113.73	111.75	111.50	112.33
	SD	2.05	2.90	4.21	3.37
	n	18	17	18	53
Low	M	116.00	114.06	114.15	114.70
	SD	2.59	4.07	2.14	3.06
	n	17	18	19	54
Combined					
	M	114.87	112.91	112.83	113.52
	SD	2.32	3.49	3.18	3.22
	n	35	35	37	107

Two-way ANOVA results revealed that the main effects were significant for Feedback, F(2,95)= 4.52, p=.013, for Ability, F(1,95)= 14.92, p<.001. However, no significant two-way interactions were found between Feedback and Ability. The feedback main effect was further analyzed via Scheffe follow-up pair-wise comparisons of the three overall treatment means (see Table 3). Results indicated no significant pairwise differences among the NF, KCR, and EF feedback conditions. The significant main effect was probably due to the pooling of the nearly-identical means of the KCR treatment (M = 112.91) and the EF treatment (M = 112.83) being substantially lower than the NF condition (M = 114.87).

Table 3.
Mean Differences for Type of Feedback by High and Low Ability (prior knowledge) Level.

	NF/H	KCR/H	EF/H	NF/L	KCR/L
NF/H(28.75)	•				
KCR/H(31.55)	2.80	•			
EF/H(35.55)	6.80*	4.00*	•		
NF/L(25.55)	3.50	6.30*	10.30*	•	
KCR/L(31.70)	2.95	0.15	3.85*	6.45*	•
EF/L(30.45)	1.70	1.10	5.10*	5.20*	1.25

*p < .05 (Scheffe)

An examination of the Ability main effect indicated that low-prior knowledge students (M= 114.85) demonstrated better attitudes than high-prior knowledge students (M= 112.13). Analyses of variance on both the attitude toward subject matter and the attitude toward group work subscales indicated no significant main or interaction effects.

Discussion

This study was to investigate the effects of type feedback and ability (high- or low-prior knowledge) in a cooperative-based instructional program. Upon completion of the lesson, students responded to a retention posttest and an attitude questionnaire.

The result of the study yielded a significant interaction between types of feedback and prior knowledge level: elaborative feedback (EF) was more effective with high-prior knowledge students. High prior knowledge students who received elaborative feedback demonstrated significantly higher in achievement than those who received KCR and NF treatment. Specifically, high-prior knowledge students seem more able to take advantage of the extra mental effort required by elaborative feedback. However, asking students to provide responses on the computer without activating greater mental effort (as in KCR or NF) might frustrate high-prior knowledge learners and result in lower performance. For low-prior knowledge students, EF and KCR treatments significantly outperformed the NF condition. However, there were no significant differences between KCR feedback and elaborative feedback for low-prior knowledge students, although the KCR mean scores were slightly higher than elaborative feedback (EF) condition.

The significant interaction of feedback type by prior knowledge in this study partially replicates the results of Dick & Latta (1970) and more recent studies by Clariana (1990), Clariana & Smith (1989), and Smith (1988) that high-prior knowledge learners benefit most from feedback that provides additional information, like elaborative feedback, but not from feedback that short-circuits additional processing, such as KCR feedback. Low-prior knowledge learners, on the other hand, should benefit most from feedback that provides less information than the elaborative feedback condition, like KCR feedback, and may be overwhelmed by feedback which requires additional processing, like elaborative feedback. In the current study, however, although KCR slightly outperformed the EF condition, there was no significant difference. This could be due fo the nature of the feedback provided in the lesson: it was highly graphical, whereas, earlier studies employed textual feedback. It might be that the amount of information contained in pictorial feedback and perceived by low-prior knowledge students is more difficult to specify.

Results on the attitude measure revealed that low-prior knowledge students had more positive attitudes than high-prior knowledge students. One plausible explanation for the results obtained is that the low-prior knowledge students in heterogeneous groups feel more supported and satisfied than other students. They may also feel privileged because their high-prior knowledge partners are always available to help them. According to Deutsch (1949), interaction improves interpersonal attraction when the interaction helps individuals to achieve personal goals. Johnson & Johnson (1989) also indicated that for the college and adult studies, cooperative experiences resulted in greater interpersonal attraction than did competitive or individualistic experiences (effect sizes = 0.83 and 0.40 respectively). In cooperative learning groups, students' goals are linked. Thus, partners seek outcomes that are beneficial to everyone in their group. Such interdependence motivates partners to invest effort toward a mutual goal, which in turn helps foster a caring and supportive environment.

By understanding the conditions under which feedback is most effective during learning, we can improve both our instructional theories and our practices. Feedback serves to provide conditions that result in mutual influence between learners and their environments. For researchers and developers in the field of educational technology, the implications of effective and efficient interactions between the learner and the learning task are critical, since newer technologies are able to make optimum use of such highly interactive environments. However, while a great deal of research has been conducted on the feedback and cooperative learning, the effects of types of feedback in group learning have not been adequately investigated between these instructional variables. Based upon the results of this and other relevant studies, the following recommendations are proposed for future research.

Additional research is needed to determine whether motivational factors may impact the learner's prior knowledge to process feedback effectively. For example, the learner's motivational states, attitudes about the instructional or topic, general self-perceptions, learning styles, and self-esteem levels may all play a part in their prior knowledge to successfully interact with feedback. A learner with a poor self-concept or general lack of self-confidence is likely to underestimate his or her prior knowledge in a majority of situations.

Researchers should examine other factors that influence cooperative learning. One such factor is ability-group composition. The present study investigated cooperative groups comprised of heterogeneous prior knowledge pairs and compared their performance to similar students working individually. Future research might wish to heterogeneous prior knowledge groups with homogeneous groups.

More research should be conducted to examine the relationship among the effects of various computer-delivered feedback and group size. Although interpersonal interactions generate more powerful feedback in cooperative groups, studies do not provide a clear answer regarding the ideal group size. In fact, the number of students in a group may depend largely on the tasks students involve. Researchers may wish to explore and clarify the relationship between group size and type of computer-delivered feedback to determine which can be employed most effectively and efficiently to boost students' performance.

Finally, researchers should examine the effects of varieties of feedback in varied new and emerging technological instructional environments. Environments are becoming increasingly available which offers an increasing range of feedback types (for example digital images, high-speed animation, video, audio, and speech). Also, technologies utilizing digitized full-motion video and virtual reality will be widely available as instructional environments in the near future, bringing with them opportunities for multi-sensory forms of feedback. Understanding how to match learners with feedback appropriate to achieve desired learning outcomes in these sophisticated instructional technology systems will certainly deserve increasing attention in the near future.

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Title:

Recognizing the Importance of Critical and Postmodern Possibilities for Instructional Development

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This presentation is based on two of my essays that are currently in press. The first, "Providing Alternative Views of Contexts, Instruction and Learning in Graduate and Continuing Professional Education Courses in Instructional Development,"1 presents primarily a critical inquiry, qualitative, action research framework for exploring instructional development with teachers, developers and other professionals who may work in a variety of disciplines. The second, "How is Instructional Development a Social Practice? Instructional Development in a Postmodern World,"2 provides several discussions on the theory and practice of instructional development from a postmodern stance. Underlying both of these essays and their ideas is a desire for more discussion and activity regarding the social responsibility of our field. Both address the question, "How is instructional development a social practice?"

Instructional development is about people. My work currently, and in the past, focuses on people and their life worlds. I am literally embedded in the lives of others. I experience tension and desire for movement, I sense ongoing contradictions, and have observed a sincere interest in learning about education and its impact on people, environments, and social relationships.

I am concerned that I cannot respond, responsibly or practically, to the question of instructional development as a social practice using the traditional language, models, and ideas of educational technology, and more specifically, instructional development. Instructional development continues to promote models of development whereby a group of well informed developers produce instruction for courses and programs external to the people they are intended for. Education (more broadly), despite attempts to encourage community intervention and participation, and to promote alternative philosophies and programs, is still confined to schools, institutions, and organizations in which educational missions are largely defined by external forces, including economic and political ones.

This should no longer be the case. The very elements (discussed and argued in a multitude of media, journals, and government reports) that are impacting society and require educational reform, are the same elements challenging our profession:

instability and uncertainty of the future
information technology movement
sociocultural and demographic changes
lifestyle changes (including work, school and recreation)

These, apart from information technology, are not new challenges. If we stop and deconstruct the present - we see a part of our past. This is why alternative perspectives and discussions, not just programs and activities, are our responsibility. When our past is present, shouldn't we be responsible and critique that past? Shouldn't we begin to ask, "Who are we now? Does our past help or hinder others?" More importantly, "Who are we responsible for?"

As a professional, I am compelled to be responsive to the life worlds of others, as well as my own. I suggest that it is an imperative that we begin to conceptualize our social practice in the following way:

Instructional development activity is located in a gray area and should conceive of itself as a practice that is not dedicated to solutions, but as a practice that contributes responsibly to the construction of people's educational life worlds; their cultural as well as technical meanings

Having accepted this proposition as the starting point for my own reflection, on the following page I offer examples of my recent work as an educator.

Program	Life world	Social Practices
Residency Program	Medical School undergoing reform: tension, resistance, fragmentation.	Interviewing, listening, negotiating, mobilizing people, educating people, developing communicative relationships through people and media, encouraging sharing and creativity.
State Board of Health	State requiring more rural physicians: fragmentation, lack of information, politics.	Encouraging collaboration, interviewing, integrating people and activities, writing a report based on actual people and events.
Dental School	Dental School preparing for reform: resistance, past experiences (negative), lack of communication, leadership issues, lack of information.	Listening, interviewing, reviewing information and programs, visiting, providing information and support, encouraging.

Primary Outcomes of a Critical/Postmodern Approach: Greater social interaction, improved student and faculty well-being, movement and integration across disciplines, formulation of ideas for action research and innovative projects, improved feedback and communication, desire for social and professional development, increased motivation and commitment to educational activity, empowerment of educational community to take responsibility and ownership of educational issues, improved environment and leadership, thoughtful and dynamic educational programs.

ENDNOTES

1 Providing Alternative Views of Contexts, Instruction and Learning in Graduate and Continuing Professional Education Courses in Instructional Development (Jamison, 1994). First presented at the "Center for Urban Ethnography Conference," Philadelphia, Pennsylvania; revised as a chapter for a work in progress (no book title currently available) on developing courses and programs in instructional development from critical perspectives. For more information on this book contact the editors: Al Januszewski, Pottsdam College, Pottsdam, New York and Rhonda Robinson, Northern Illinois State University.

2 How is Instructional Development a Social Practice? Instructional Development in a Postmodern World (Jamison, 1995). Chapter for a work in press (no book title currently available) on current theory and practice in educational technology. Charles Dills, Editor. Proposed publication date is Fall 1995. For further information contact: Larry Lipsitz, Educational Technology Publications, Englewood Cliffs, New Jersey.

Instructional Development: Traditional and Alternative Frameworks

Traditional Instructional Development Approach

Use of Models, Systems and the Systems Approach to Instruction

Dependence on Instructional Design (Detailed Plan)

- Define Problem (Front-end Analysis): Needs Assessment, Problem Identification, Job Analysis
- Define Outcomes: Task Analysis
- Define Detailed Objectives
- Specify Methods

Determine Procedures and Media to Support Instructional Design (Plan Patterns of Social Interaction and Technologies)

Develop Resources (Identify Materials, Facilities, Personnel)

Evaluate

Revise

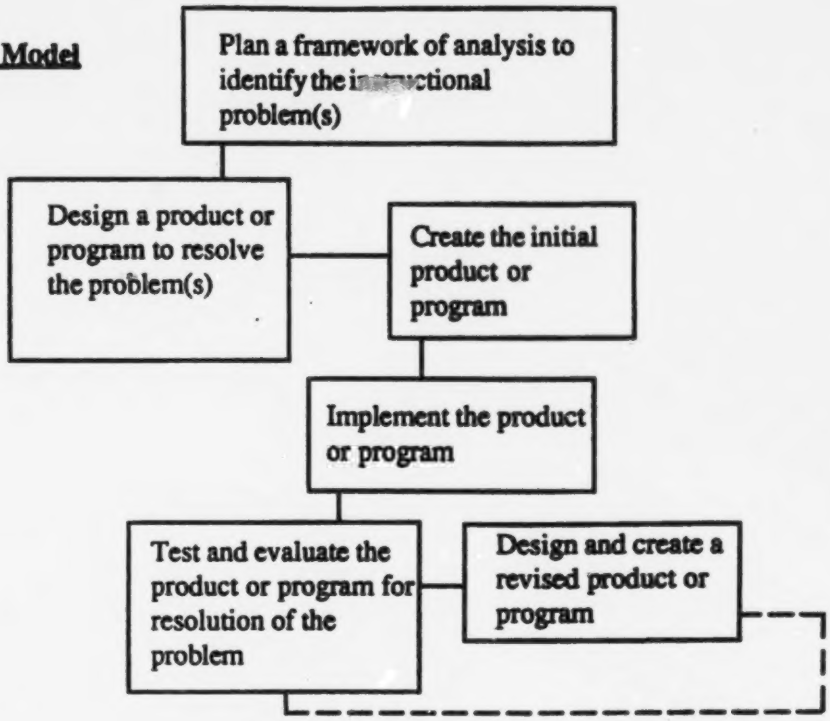
Implement

Alternative View of Instructional Development

CONTEXTS	DIFFERENT WAYS OF INQUIRING INTO CONTEXTS
Political Context: Language and Power	-Critical Inquiry -Autobiography
Social/Cultural Context: Social Systems	-Ethnography -Holistic Ethnography -Ethnography of Communication
Learner/User Context: Agency and Meaning	-Participatory Action Research -Cognitive Anthropology
Environmental Context: A Sense of Place	-Phenomenology -Semiotic Approach -Case-Study
Instructional Design and Development Context: Imagination, Intuition, Art and Science	-Grounded Theory -Policy Research

Figure 1., Traditional and Alternative Frameworks for Instructional Development

Technical Model


Plan a framework of analysis to identify the instructional problem(s)
Design a product or program to resolve the problem(s)
Create the initial product or program
Implement the product or program
Test and evaluate the product or program for resolution of the problem
Design and create a revised product or program

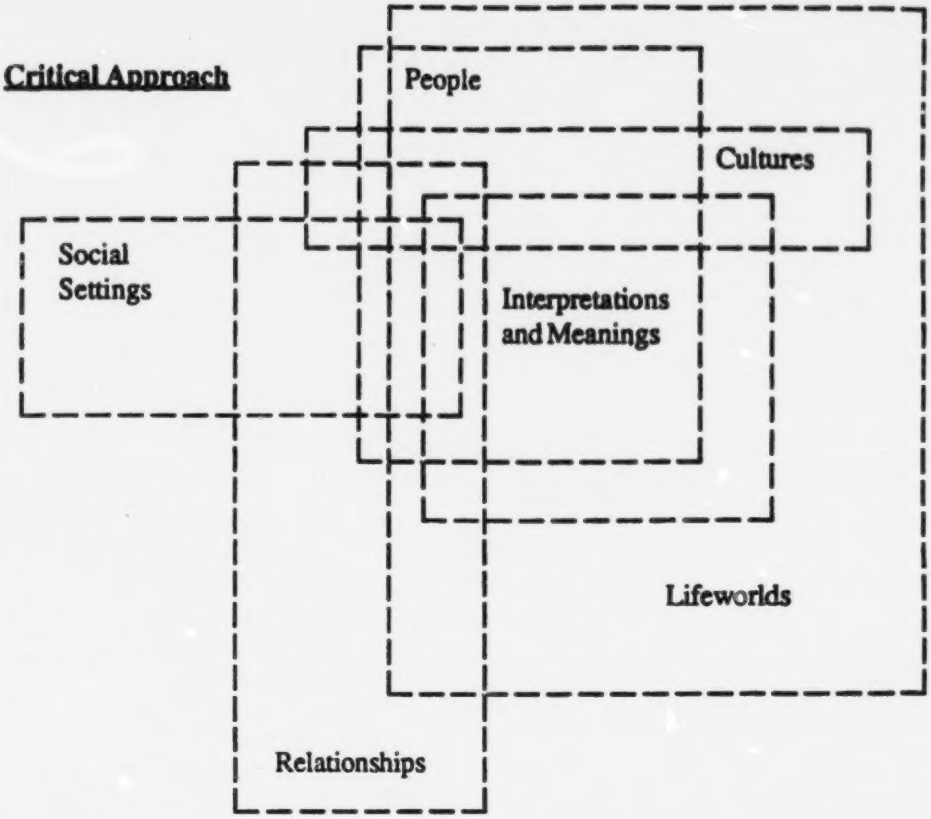
Associated Concepts

nomothetic (universal law, one paradigm)
reflective of reality
order through differentiation and separation
passive and static
strives for control and homeostasis
surrenders people and settings to "the problem"
monologic discourse
etic view (outsider's perspective)
imposes resolution from the outside
purported to be based on the notion of
"naturally occurring systems"

model dictates practice
hierarchical and authoritative
mechanistic
autonomous
based on supposed "objective" reality
products and programs are universal and
generalizable to other situations
search for function and example

Figure 1 Technical Model of Instructional Development and Associated Concepts

Critical Approach



Associated Concepts

idiographic (case-based)
search for meaning
embraces uncertainty and ambiguity
interpretive and responsive
complementary and contradictory
acknowledges tension and struggle in settings
people, setting and developer are active participants in construction of lifeworld
dialogical and conversational
personal and metaphorical
emic (insider's perspective)
bridges theory and practice
multidimensional
participatory
explores cultural, subjective reality
representative of part of reality (partial)
competing paradigms are viewed as representative of complexity
process focuses on construction and interpretation of meaning
conceptual and multiple meanings possible
local meanings provide understanding
engages through exploration
inquires into the meaning of difference

Figure 2 Critical Approach to Instructional Development and Associated Concepts

Title:

Teaching about educational technology in a Master of Science in Education program from a socio-cultural perspective

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There are three basic aspects of graduate programs in educational technology. The first focuses on the essential concepts, skills, principles, and procedures that students should know/or be able to do in order to function well in our field. Examples of this sort of thing include writing objectives, doing task analysis, and producing "good" overhead transparencies.

The second deals with the theoretical and conceptual bases in which the essential skills, principles, and procedures are grounded. Examples of this include perception theory in message design, S-R association in behavioral approaches to instructional design, and expertise oriented or connoisseurial approaches to program evaluation.

The third is concerned with the foundations of the field. Here foundations does not means the introductory issues and ideas of the field. Here it means the "cultural foundations" of the field. It refers to those issues and ideas which are the foundation of the "culture of educational technology". Examples of this include the history and definition of the field, ethical and professional issues of the field, and the hidden implications of our research methodologies and design practices. Most teaching and course work in the field had done an admirable job of dealing with the first two of these aspects but seems somewhat reluctant to address the third.

Purpose

The purpose of this paper is to describe the way in which foundations issues are covered at an institution which grants masters degrees in education in the area of educational technology.

There are two ways in which this is done in the program in educational technology at SUNY Potsdam. The first is to build it into the skills focused courses. In the course on instructional design the is time given to the subject of unintended learning outcomes. In the course on program evaluation there is time given to the different approaches and their implications in program evaluation. These subjects are not a prime area of study in those two courses. The intent behind including these topics is twofold: 1) to raise awareness about the implications of our activities in the field of educational technology; and 2) to raise the idea that the practice of the field often covers much more then is intended (we are responsible for more than what we intend).

The second way in which foundations issues are covered in the educational technology program at SUNY Potsdam are in courses which were specifically designed to do so. I teach two courses (one of which is required of all students in our program [their choice]) (GRED 615) *Critical Issues in the use of Technology in Education* and (GRED 625) *The History and Philosophy of Instructional Technology* which focus on foundations issues. Both courses cover definitions of educational technology, differing conceptions of educational technology, and the concept of professionalism. Both course explore the importance of conceptual clarity. But the similarity ends there.

The History and Philosophy of Instructional Technology (GRED 625)

The purpose of this course is to contribute to a conceptual understanding of educational technology. This is done by tracing the development of some of the popular concepts and ideas in the field of educational technology. It includes identifying and analyzing the concepts, root ideas, and strands of thought that have existed in educational technology since the first official definition was published in 1963. This course also analyzes the contributions of some of the important people in the field of educational technology in the last fifty years.

This course should help to answer the questions 'why do educational technologists think the way they do about educational technology?' and 'how has that way of thinking changed with time?'. Historian George Boas stated, "the history of ideas tells us among other things how we got to think the way we do-and if that is not of importance one wonders what is" (Boas, 1969, p. 3).

In the words of Ludwig Fleck:

> Whether we like it or not we can never sever our links with the past complete with all its errors. It survives in accepted concepts, in the presentation of problems in everyday life, as well as the language and institutions that we employ. Concepts are not spontaneously created or generated but are determined by prior thought - (Ludwik Fleck, 1979, p. 9).

Why history and philosophy?

Actually this course is about the intellectual history of the field of educational technology. As such it is about both, the history and the philosophy involved with educational technology, but I tend to approach it more from a historical perspective.

I think that history is strongly connected with the concept of change in two ways. First, the study of history helps to show how things have changed and helps to explain why they are the way they are at present. Second, history provides the understanding which is an essential component of reflective thought. The study of history can help maintain traditions, help individuals to stick to their roots, if the roots are valued strongly enough. But historical analysis may also provide more options. An historical understanding can help us to 'break out' of past patterns or shift emphases if it seems important to do so. History can greatly contribute to the conscious decisions that are made about change.

Fleck described the problem of writing a history of an academic field:

> It is very difficult, if not impossible, to give an accurate historical account of an academic discipline or a field of study. Many developing strands of thought intersect and interact with one another. All of these would have to be represented; first, as continuous lines of development and, second, in everyone of their many intersections and connections. Third, the main direction of the development, taken as an 'idealized average', would have to be described separately and at the same time. The continuity of the line of thought that has already been mapped out must continually be interrupted to introduce other lines of thought. The main current of thought would often have to be held up in order to investigate and explain any connections. Often, much has to be omitted to preserve the main current. Instead of a description of dynamic interactions one is often left with an artificial and arbitrary scheme (1979, p. 19).

Fleck is describing the difficulty in developing an historical document that follows a chronological order yet maintains a flow which keeps the reader's attention. He admits that many things are happening simultaneously. Ultimately, it is up to the disgression of the historian and writer to determine what content is included in the study and what the sequence of presentation will be.

I faced the same kind of problem when organizing my history course. In order to tell the story of the history of educational technology and analyze that account, much of the history of the field had to be left out. The course is limited by necessity. I now analyze and interpret educational technology by looking at the development of the field through two distinct yet related filters or screens. Looking at the field of educational technology through these two screens limits the scope of this course both by necessity and by definition. One simply cannot consider and give equal treatment to all of the factors which contribute to the development of an academic area of study (Fleck, 1979) in one graduate level course.

The first of these filters or screens was the intent and effort to professionalize the audiovisual field. Many members of the audiovisual field were interested in professionalizing and gaining status for the field but James D. Finn spearheaded this movement. Finn wrote and spoke extensively about the need for audiovisual specialists to become professionals. Finn formed the first academic department called Instructional Technology at the University of Southern California. He was instrumental in obtaining large amounts of funding to conduct conceptual and theoretical studies of the field, including the Technological Development Project which funded the effort to write the 1963 definition of educational technology. Finn also sought the funding to create an organization analogous to the "French Academy" for the preservation of the language inside the professional organization of the field. The efforts to increase the prestige of the audiovisual field were political. The concepts and ideas which were central to the field of educational technology were affected by these politics, so politics and political overtones are included in this course.

The second of these screens or filters, the influence of science and engineering on the audiovisual education movement, is somewhat less political. The conceptions of science and engineering influenced the interpretation of many of the concepts and ideas that were central to the field of educational technology and were included in the field of educational technology. It is true that in some instances the desire to gain professional status gave reason to some involved in the field to adopt particular conceptions of science and engineering in education. But there were many instances when the idea of gaining status for the field was not a concern to individuals in the field. They simply adopted a particular conception of science or engineering based on their individual belief system or their academic background. As a matter of influencing the activities of the field there was still politics involved in these latter cases, but there was much less conscious thought and effort on the part of the members of the field involved in this level of politics, decision making, and action.

Frequently, particular ideas or conceptions are introduced into professional dialogue for personal reasons. Over time this motivation becomes hidden as particular ideas grow in their acceptance. Historical investigations bring this hidden motivation to light. Historians of educational technology can contribute to the self-awareness of the field. They can do this by helping to make the lost and hidden purposes into conscious ones. This result, in turn, will open them to a critical appraisal that may rekindle the discussion of the moral and ethical responsibility of the professional.

This course is not expected to provide any new prescriptions for action, nor is it designed to predict what any new actions in the field of educational technology might be. It is undertaken with the intent of analyzing the intellectual basis for the field of educational technology and bringing some of the less obvious ideas that are involved in educational technology to a more conscious level.

Critical Issues in the Use of Technology in Education
GRED 615

> A good part of the work called "theorizing" is taken up with the clarification of concepts and rightly so. It is in this matter of clearly defined concepts that social science research is not infrequently defective (Merton, 1957, p. 114).

An often overlooked consideration in the theory, research, and practice in the field of educational technology is a lack of conceptual clarity and understanding.

The traditional answer to the problem of conceptual clarification is the commonly heard prescription: define terms precisely. Educational technologists often do this when they provide operational definitions in their empirical studies. But it seems evident that previous attempts at defining are at least partially responsible for the differing viewpoints or conceptions which exist in the field today. They are at least partly responsible for the difficulty that is encountered when trying to understand the concepts and terminology of the field that are often open to differing interpretations.

But there is a more fundamental conceptual problem. The problem is the meaning of educational technology itself. There have been a number of popular interpretations of the term "educational technology" since its inception. This has caused some problems for the field. The formal meaning of the term "educational technology" was contested from its earliest use.

Educational technology has prided itself as being an "applied" field. As such, its research emphasizes the practical or prescriptive aspects of instruction. Historical studies focus on understanding their subjects. They are not always thought of as practical. Recent content analysis studies of major professional journals and doctoral dissertations in the field of educational technology revealed that very few conceptual or historical studies have been conducted or published (Januszewski & Young, 1990; Caffarella, 1992).

Meaning is strongly tied to interpretation. There is a hesitancy on the part of members of given fields of study to question their own presuppositions or interpretations about their language habits (Fleck, 1979).

Judging from the number of articles published in the professional journals of the field of educational technology, studies which do focus on concepts, meaning, and language are not warmly received by the profession.

Concepts give our experience direction and meaning. "Our concepts structure what we perceive, how we get around in the world, and how we relate to other people" (Lakoff and Johnson, 1980, p. 3). This suggests that the concepts that we use, and the conceptual systems that we think with, are the basis of how we get through our daily lives.

Lakoff and Johnson described this idea by saying:

> But our conceptual system is not something that we are normally aware of. In most of the little things we do every day, we simply think and act more or less automatically along certain lines. Just what these lines are is by no means obvious. One way to find out is by looking at language. Since communication is based on the same conceptual system that we use in thinking and acting, language is an important source of evidence for what that system is like (1980, p. 3).

The study of concepts can help us to determine the significance of events and processes as well as just describing them. Studying concepts can also reveal more subtle aspects such as the emphasis which may be placed on certain words and actions. The subtle aspects included in certain concepts can affect professional practice.

Inherent in this last idea is the connection between history and concepts. One way to study language is to look at its historical development. This can be a long and arduous process. But if sufficient evidence is gathered and seriously considered, great insight and understanding can be attained.

Some teaching strategies and considerations

Reaction Papers

For the most part I believe that it is important that the class sessions be guided by student discussion. I still have things that I want to get across to the students but I can build that into a conversation rather than make a specific presentation. In order to prepare my students for the first eight weeks or so of these two classes I ask them to write "reaction papers". This is an idea I adapted from Don Ely at Syracuse University. A reaction paper is a 500 word maximum, discussion of the students thoughts, opinions, or reactions to the readings assigned for that day. It is intended to be personal. Students sometimes state how this reading made them think about something they never thought of before. Sometimes they can give an example from their own lives. They are not graded, but I "respond" to them by writing comments, notes, and questions on them and returning them the following class session. These reaction papers are the starting point for the discussion in class for that day. Reaction papers have several advantages: 1) students must come to class somewhat prepared; 2) students usually 'process' the information in the readings and put their own personal spin on some ideas; 3) all students have an opportunity to organize and express their opinion. Reaction papers could be used in other settings and with other purposes but I find that this works for me.

Seminar Session Leadership

Another activity that has worked well for me is the student run and operated seminar session. This tends to work better in the class size is smaller. I'm inclined to use it more in the critical issues class than I am in the history class. There are two ways that this type of seminar session could go and much depends on your (faculty member's) level of comfort with giving up control. First, there is the type where the faculty member chooses the topic and the readings and the students prepare for and conduct the class session. Here they run the class, perhaps much like you would.

The second type is where the students select the topic and the readings and run the class session. This can be a little more wide open so be cautious. I like to have the students clear the topic and the readings with me in advance so I can help them select good readings and be certain that the topic fits into the intention of the course. More often then not students like to assign other students lots of readings but tend not to like to be assigned lots of readings by you. The selection of readings based on an intended goal is helpful to student development. Group seminar leadership can work well.

Final Papers

Most faculty members are familiar with this idea. I tend to use one of two kinds of papers. First, there is the paper that may be the result of a seminar session. Here the student incorporates and organizes much of what happened at the session. It also includes additional research gathered after the session to sharpen arguments and add and support points.

The second paper is the research paper. I tend to use this more in the history class. Papers take one of three basic forms: 1) a biographical paper, 2) a history of some specific idea or concept in the field, and 3) a time limited history of the field. These can be difficult at the Masters level because students have not yet become familiar with many of the nuances of the field. Students are encouraged to interpret as well as describe activities in the field. Be prepared to meet with students outside of class time in order to support their efforts.

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Title:

Understanding the Critics of Educational Technology

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Purpose

The purpose of this presentation is to provide some conceptual frameworks for understanding critics of Educational Technology. These conceptual frameworks will be developed and fleshed out by using a series of concepts, approaches and techniques of historical analysis from the area of Intellectual History, specifically the History of Ideas. We hope to demonstrate how studying history can help members of the field of Educational Technology to gain a clearer understanding of the problems and challenges that they face.

This study should help to answer the questions 'why do critics of educational technologists think the way they do about educational technology?' and 'how has that way of thinking changed with time?'. As historian George Boas stated, "the history of ideas tells us among other things how we got to think the way we do-and if that is not of importance one wonders what is" (Boas, 1969, p. 3).

In this study, understanding the critics of the concept of educational technology is the goal. But understanding has not always been seen as a useful end by many of those involved in the field of educational technology (Yeaman, 1990). Many in the field thought that an "understanding" was useful in so far as it was a necessary step in accomplishing some goal or task. They considered it to be a necessary step toward explaining or predicting a desired outcome (Koetting, 1983). Usually the larger goal was to provide a prescription to be used in professional practice. This study is not expected to provide any new prescriptions for action, nor is it undertaken with the aim of predicting what any new definition of educational technology might be. It is undertaken with the intent of bringing some of the less obvious ideas that are involved in educational technology to a more conscious level.

In order to fairly assess the critics of educational technology and their history one must decide on an inception point for the field of educational technology in order to begin the analysis. One could trace the beginnings of educational technology back to the educational practices of the ancient Greeks, or Comenius, or Pestolozzi, or Herbart (Saettler, 1990). But this could be somewhat misleading because much of modern day education has its beginnings in the ideas of these individuals. It would be more accurate to say that educational technology is a twentieth century phenomenon with its roots in the educational ideas of the progressive education movement (Shrock, 1990) and with the onset of the industrial revolution. The position taken in this presentation is that it was not so-called empirical considerations applied to schooling that led to the construction and development of the idea of educational technology. It was the interpretation science and industrial development, which were of great social and psychological significance, that contributed to the development of the concept of educational technology (Kliebard, 1987; Callahan, 1962).

Methodological Concerns

The history of ideas: a description of an umbrella like approach

Studies in history (in this case of educational technology) can be viewed from differing domains of intellectual history (Higham, 1977). Intellectual history is the study of the role of human thought in shaping the history of some given entity or occurrence. Intellectual history can itself be analyzed in terms of two contrasting tendencies or methods that are followed to investigate the role of thought in history. The essential difference between these two methods has to do with the level of conscious thought that a historian chooses to highlight (Veysey, 1977). Studies in the history of ideas often cross traditional disciplinary boundaries seeking important or "great works", and coherent expressions of thought written about a topic in question. Studies in what is called the history of culture focus more on the development of the group consciousness and the multiple topics or influences that help to shape the thought processes of a group.

The difference between the history of ideas and the history of culture is a matter of degree. There is much to be learned from the study of how consciously articulated ideas become a part of a "thought collective" in a given field of study (Fleck, 1979; Kuhn, 1970). Although these two approaches to intellectual history have different purposes, they complement and support each other (Higham, 1977).

As originally conceived, the history of ideas approach was both a method and a theory of history (Lovejoy, 1940). Studies of the history of ideas often analyzed some particular idea at a singular point in time, exemplified by Hollinger's (1985) *In the American Province: The Problem of Pragmatism in American History*. They also could be descriptions of the changes in the meanings of particular ideas over time, such as Lovejoy's (1940) *Great Chain of Being*. As a method, the history of ideas focused on the "root ideas" (Lovejoy, 1940) which constituted a broader concept or idea. This approach was similar to the approach used in analytic philosophy which developed in the early twentieth century. These root ideas were often the "necessary and sufficient conditions" of the idea. Establishing these conditions established the boundaries of a particular idea. The reasoning was that if the essential components of an idea could be understood, then the meaning of the idea would become clear.

The history of ideas is still concerned with much of the same subject matter as it always has been, but now it seems to be a much "looser" approach in which the distinction between the history of ideas and the history of culture has diminished, as in Foucault's studies such as *The Archaeology of Knowledge* (1972) and *The Order of Things* (1970). Studies under both labels have been used to examine the same topics. In fact, many scholars believe that the titles "history of ideas" and "history of culture" should be discarded in favor of intellectual history (Kelley, 1990). What may be of some interest to the field of educational technology is that the history of ideas has included both the ultra rational and objective studies of Lovejoy (where if the proper analysis were conducted the truth would reveal itself) and the postmodern work of Foucault (where he tried to discredit any a priori method).

Potential problems with the approach

There are at least four potential difficulties with the way that the history of ideas is conducted as a research method. First, the necessary and sufficient conditions approach has been called "atomistic" (Mink, 1968). The criticism here is that by concentrating on the component parts or root ideas of a particular concept, the "whole" of the concept or idea is neglected. It is argued that while it is important to identify the components of an idea, it is the interaction of these components or root ideas that give meaning to the whole of the idea under study. The atomistic nature of the traditional method of the history of ideas relegates this interaction to a secondary status. This criticism may be characterized by the conventional logic that "the whole is greater than the sum of its parts", a notion that is associated with systems theory in the field of educational technology.

Second, it has been suggested that the traditional approach results in an elitist perspective (de Carvalho, 1988). The written record of the past is limited. By and large, the records that exist today were written by people, most often males, who were either wealthy or were afforded the special opportunity to record their thoughts and observations. In proportion, very few documents exist that were produced by "commoners". Commoners simply did not have the opportunity to contribute to the literature in the way that elites could. This resulted in a written record which was largely produced by elites. Focusing solely on this written record could result in a limited perspective on the subject being studied if this limitation is not properly acknowledged in advance.

Third, it has been noted that the traditional approach is not sufficiently concerned with matters of context. While it is true that the purpose of this method is to understand the context in which a term is used or an idea is expressed, it has not often acknowledged that the investigator is also operating within a specific context: the present. Without properly considering the context in which the investigator is working, the outcome of a particular study may not be "objective" (Mink, 1968). Due in part to these criticisms the thought that the history of ideas is a singular methodology seems to have faded. The history of ideas is now more frequently thought of as a form of intellectual history (Higham, 1977; Vesey, 1977).

Finally, the anti methodological stance taken by Foucault has brought the entire notion of objectivity into question. Without any possibility of an objective history the utility of historical projects has been called into serious question.

There is no single correct way to conduct a study in the history of ideas (the history of ideas is to historical/conceptual research what survey research is to quantitative research - there are many factors which are specific to individual accounts). The history of ideas has become an umbrella concept where the specific procedures of investigation and analysis are defined differently in each study. Many historians who work in this area agree that there are several important factors to consider when conducting a study in the history of ideas.

Five factors in the history of ideas

1) Have precise boundaries for the idea being studied (Lovejoy, 1940; Boas, 1969; Kelley, 1990).

2) Be aware of the context in which the idea is being studied. Meanings of words and the ideas that they connote change with time (Lovejoy, 1940; Boas, 1969; Fleck, 1979; Kelley, 1990).

3) Be prepared to cross traditional disciplinary boundaries when studying an idea (Lovejoy, 1940; Boas, 1969; Kelley, 1990).

4) Be aware of the 'metaphysical pathos', the attitude a writer portrays toward the idea. The language used by the writer can show an idea in a positive or negative light (Lovejoy, 1940; Boas, 1969).

5) Remember that the history of ideas is not confined to semantics. Ideas often have more than one name (Lovejoy, 1940; Boas, 1969).

Many analyses now fit under the umbrella of the history of ideas.

Definitions and historical studies

Definitions are important when studying history. They are especially important when conducting studies in the history of ideas because definitions often set the boundaries for a study. Historian David Fischer (1971) identified fifteen kinds of definitions that historians have frequently used in their work. He reasoned that using different kinds of definitions in studies may yield different results.

> There are many different kinds of formal definition. A historian ought to choose consciously and carefully from the range of possibilities available to him. Imprecision results not merely from an incomplete or inaccurate or inconsistent definition, but also from the use of an inappropriate definitional type. It could be one or more of the following types, *some of which overlap* (p. 277).

Of the fifteen definitional types posited by Fischer, there are four that are of particular interest for this presentation on educational technology. They are:

1. A definition by genus and difference locates a term within a larger class, and then supplies specific differences (p. 277).

2. A theoretical definition might include a statement of principles involved in an idea (p. 278).

3. An analytical definition defines a thing by detailing its parts (p. 279).

4. A stipulative definition introduces a wholly new expression into the language or gives a new and special meaning to an old expression (p. 278).

The Presentation Format

Acknowledgment of limitations

There are, of course, a number of ways in which the criticisms of Educational Technology could be conceptualized or grouped. Certainly too many to be discussed in one presentation. It is also likely that many of the possible conceptual frameworks for analyzing these criticisms would overlap. That is, certain individual criticisms could fit in more than one framework for analysis.

The Format

This presentation will revolve around the following conceptual frameworks for analyzing the criticisms of Educational Technology: 1) concerns about the development of man-machine systems; 2) concerns about technological momentum; 3) concerns about individualizing instruction; 4) concerns about gender inequities and bias; and, 5) concerns about dehumanization.

A summary of the highlights and findings of each of the five papers follows.

The analysis of man-machine systems centered on the relationship between people and machines, specifically their interactions and human self-image. The major points identified in this paper include:

1) Scientific inquiry and technological development leave a void in the spiritual and artistic side of people which needs to be expressed.

2) Technology, as an extension of people, has threatened to sever human wholeness by separating the cognitive (mind) from the psychomotor (body).

3) Engineers (and those who view education as engineering) form and develop their moral standards based on the things that they build rather than for and from the society for which they build them.

The analysis of technological momentum encompasses the following ideas: using technology because it is there; the implementation of technology requiring the need for more technology; and the deskilling of teachers because of the ever increasing use of technological design. The major points identified in this paper include:

1) That the are 2 kinds of technological momentum: a) that there is too much technology in education, and b) that technology is being introduced into education too fast.

2) Technological evolution in education has accelerated. In some instances this has resulted in the deskilling of teachers.

3) One of the major facets of technology is the concept of control. Critics of educational technology have argued that it is the technology which controls teachers, learners and the learning process rather than teachers and learners controlling technology. The implementation of technological developments needs to be controlled and not left to chance.

The analysis of individualized instruction addresses the criticisms of self-instructional systems, including; programmed learning, computer assisted instruction, and independent studies. The major points identified in this study include:

1) Individualization of instruction has meant segmenting and providing self paced approaches for individuals to learn the same material. It does not mean the selection of different material or subject matter for each learner.

2) Individualization maintains the status quo by maintaining the power and authority of the teacher in an "individualized" environment rather than a group paced one.

3) Individualization in education threatens the group and social aspects of education.

The analysis of gender inequities and bias will include focus on computer utilization from 1983-1993. The major points identified in this paper include:

1) Criticisms focus of issues involving content, form, and function. The issue of content examines the design and subject matter of software. Form is concerned with the machine hardware. And function is related to issues of access.

2) Critics use qualitative, quantitative, and conceptual methodologies to show gender bias in the use of computers in education. Recent research suggests examination of the issue from a societal perspective rather than a technological one.

3) Educational computing experiences must allow for differing ability and interest, as well as different types of interactions.

The analysis of dehumanization will address the following: alienation because of machine implementation, and the deskilling of students and teachers because of the introduction of technological innovations. The major points identified in this paper include:

1) Technology has been represented as being value neutral. Critics challenge this idea because there are values inherent within the technology, such as efficiency, machine utilization etc..

2) Technological expansion has affected the language that is used in education. The metaphorical structure of language leads to seeing the world in technological, rather than other terms.

3) Teachers are often viewed as managers and facilitators rather than educators. Examinations of values associated with education question the desirability of this view.

Concluding comments and summation

If the criticisms of the concepts, principles and implications of educational technology can be traced back in the literature of the nineteenth century then it seems reasonable to think that the critics of the ideas behind educational technology have been around as long as these ideas which are important to educational technology have been.

I would like to make three points in closing. First, if Bob Heinich is right, and educational technology is a part of the larger idea of technology (1984), then it seems reasonable to think that many of the criticisms of educational technology will be anchored in criticisms of the larger idea of technology. And, in fact, this is accurate. Commentary on technology dates back to the first (or the early part of the) industrial revolution. This commentary, analysis, or criticism seems to take one of two basic forms. It appears as if one form is part of the world of literature like Shelley's *Frankenstein* or Vonnegut's *Player Piano*. Jim Finn had run ins with Griswold and other "humanities types". The other basic form is a more scholarly/academic or social science based approach. This group can be represented by the work of Karl Marx, Lewis Mumford, and Jacques Ellul. There are many more commentaries in the literature that follow a social science based approach. Both groupings of these critics tend to focus on the areas of "the human condition", the meaning of progress, and moral questions about technology.

The second thing is that there are a good many critics of educational technology represent other perspectives in the broader field of education. Michael Apple and Henry Giroux are two of many important writers in this area. While these critics raise many questions it seems to me that they all include the same base notion. That educational technologists and others may have fundamental differences in the purposes and meaning of the concept of education, and in the processes involved in bringing those purposes to reality. A serious conceptual question about education.

Third, as the field matured, a number of criticisms were posed by individuals within the field. These criticisms included moral, epistemological, and procedural questions. These criticisms were the result of different interpretations of the concept of educational technology within the field itself. This resulted in alternative priorities, plans, and paradigms for educational technology (e.g.. Eraut, 1985).

There have been many criticisms leveled against the ideas and use of Educational Technology. This presentation will have served as a way to see the relationships between various approaches or conceptual frameworks of the criticisms of the field. Understanding the various criticisms and their relationships to each other is essential to moving our field forward.

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Title:

Individualized Instruction: A History of the Critiques

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The improvement of the educational system and the improvement of the act of teaching is a common goal of all educators. Increases in class size, time constraints, and class material have pressured educators to develop better ways to present instructional material. This pressure has led to numerous teaching innovations, including many in the area of Individualized Instruction.

Examples of Individualized Instruction can be seen as far back as ancient Greece with the teachings of Socrates, and recently in the development of sophisticated Computer Managed Instruction in the 1980's and 1990's. Examples of programs of individualized instruction in elementary, secondary, and continuing education have increased throughout the twentieth century, as the demand for new teaching innovations has increased. As in the case with any educational innovation there has been a substantial amount of review of these programs, both of the quality of instruction delivered and of their foundations in theory. These reviews have been both positive and negative.

This paper concentrates on a history of the critiques of Individualized Instruction in the twentieth century, especially form 1960 to present. Three examples of Individualized Instruction will be specifically covered, these include: Audio-Tutorial by S. N. Postlethwait, Personalized System of Instruction by Fred Keller (PSI), and Computer Assisted Instruction (CAI). Recent trends towards Computer Managed Instruction through Instructional Development were not included in this paper. These three examples were chosen based on their importance to present day education.. Popularity does not in itself make something lasting and sound. Widespread acceptance of technique without sound evidence for that technique is just the formula for producing another "educational fad" (Powers, 1972, p.4).

The discussion of each type of Individualized Instruction will include: a brief description of the theory and methods, a summary of the benefits as indicated by the designers, an account by the critics, and a response by the supporters is applicable. A final section addressing general critiques of Individualized Instruction will be included at the end of the document.

Audio Tutorial

Audio-Tutorial is a method of Individualized Instruction developed by S. N. Postlethwait in 1961 at Purdue University. His purposes were to find an improved method of teaching botany to a larger number of college students and to effectively assist the students who possessed only limited backgrounds in the subject (Snortland, 1982, p.3). The development of an A-T program requires a significant amount of planning and time by the instructor before the course is implemented. Although there is some room for modification for specific programs to be taught, the general principles remain the same. The student has access to a taped presentation of a specifically designed program that directs their activities one at a time. The criteria for an effective educational program that Postlethwait used in designing A-T are repetition, concentration, association, unit steps, use of the communication vehicle appropriate to the objective, use of multiplicity of approaches, and use of an integrated experience approach (Couch, 1983, p.6).

There are many benefits of Audio-Tutorial as described by Postlethwait (1972), these include: an emphasis on student learning rather than on teaching, self-pacing, allowing better students to accelerate, not having students distracted by each other, more individual attention if desired, more students accommodated in less laboratory space with less staff, increased responsibility of learning on the students, and an easy standardization of instruction.

Some of the major criticisms that are common to Audio-Tutorial courses were illustrated by Snortland (1982, p4) upon evaluating a course in Graphics design.

1) "Generally, the students with previous drawing experience were able to endure and prosper from the individualized approach and enjoy it to a greater degree than those who began the course with little or not prior training in the graphics language."
2) "Self Pacing was a definite problem....many students were not ready to master the additional self-discipline required in order to maintain a steady pace."
3) "...the A-T...approach is not for everyone."

The first of these criticisms deals with background knowledge, while the last two deal with responsibility. Some students respond to the responsibility placed upon them, while others do not.

Snortland (1982, p.5) explains "Since many freshmen students are not ready for additional self-discipline required of them in the A-T format, the choice of either a structured approach or an individualized approach should always remain open...".

Another criticism of A-T, especially from modern instructional developers, is that A-T places to heavy an emphasis on teacher control. All of the material and the learning and feedback procedures are dictated by the instructor. The criticism is that this is a severe form of teacher control over the student.

Still further criticism deals with the fear of the machine taking from man the position of instructor. Snortland (1982, p.5) replies to this "Man vs. Machine" argument:

> There is a danger with this teaching method in thinking that the machines can pretty well take over and thereby reduce the need for well qualified and professional teachers. Even though an efficient, workable, and effective teaching program is fairly well in place and de-bugged, it will still be essential to have a core of dedicated teachers around to keep the system oiled and do the many "in house" things necessary to maintain the credibility and integrity of the system as originally designed. There are so many factors which affect the motivation of the students, checkers, tutors, and teachers, that the machines by themselves, without human support, would not only be ineffective, but very likely disastrous.

Another criticism is that there is a high initial dropout rate of students enrolled in A-T courses. The problem centered around the fact that some people were not prepared to take on the amount of responsibility that was required of them in order to complete the course. This is an even bigger problem when one considers that the courses most likely to need an A-T setup are predominately courses with high enrollments and a specific amount of material to be covered for the semester. a majority of these courses are freshman courses to begin with. This makes this problem self defeating if not addressed.

As is the case with most forms of individualized instruction, Audio-Tutorial can be modified to meet the needs of a particular situation. If effectiveness were the only criteria measured, then the conclusion regarding A-T's effectiveness compared to conventional instruction favors S-T by two to one (Couch, 1979, p.3). One must be careful to measure both the benefits and the consequences of an A-T program before implementation.

Personalized System of Instruction

The Personalized System of Instruction, also know as the Keller Plan, was introduced by Dr. Fred Keller in 1964. The Keller Plan is based on 10 accepted educational principles: active responding, positive conditions and consequences, specification of objectives, organization of material, mastery before admancement, evaluation/objective congruence, frequent evaluation, immediate feedback, self-pacing, and personalization (McGraw, 1975, p.4).

The five basic features of the Keller plan are: self-pacing, unit mastery, student tutors, optional motivational lectures, and learning from written material (Couch, 1983, p.7). The design of a course using Keller's Personalized System of Instruction consists of:

> ...breaking the material of the course into several units. .... It entails dividing the material into units one to two weeks long. .... As each unit of material is covered, specific learning objectives are given to the students. These state exactly what a student must know to pass a unit quiz (Grasha, 1977, p.8).

The proper implementation of a PSI Keller plan can be neatly divided into five identifiable states: assessing entering behaviors, specifying objectives, selecting resources and activities, establishing and implementing the course framework, and evaluating student performance (McGraw, 1975, p.6).

Some of the benefits of a Personalized System of Instruction include:

1) "PSI students perform better on all types of examination. PSI students also demonstrate longer retention of material than students in more conventional courses" (McGraw, 1975, p.16).
2) Students report "...learning more than do students in a conventional course" (Grasha, 1977, p. 7).
3) "...student responses in the affective domain are positive toward the PSI approach.", "students have more positive attitudes towards the course" (McGraw, 1975, p.16).
4) PSI can "...increase the motivation for further learning" (Grasha, 1977, p.7).
5) PSI students receive "...a much larger proportion of higher grades, despite controls for grading criteria." (McGraw, 1975, p.20).
6) "Keller Plan students...study more per week than do other students...and they do better on achievement tests than do traditionally-taught student" (Grasha, 1977, p.8).

Given the large amount of benefits of PSI, there have been an equally large number of criticisms. Many of the criticisms are common among many types of individualized instruction. The following are criticisms aimed specifically at the Keller Plan, yet many could apply to Individualized Instruction as a whole.

A first criticism is that there are many types of proven instructional strategies that deal with large groups. Because of the very nature of PSI, these are not possible (Couch, 1983, p.4).

A second criticism is that there is a higher dropout rate in the PSI programs. If a student falls behind early in the program, the likelihood that he/she will drop out because they feel that there is no chance to catch-up with the rest of the class. As stated by Born & Moore (1978, p.2):

"That PSI causes or contributes to student procrastination has been effectively argued".

Their criticism is that procrastination goes unnoticed because students are not monitored often enough. Conyers, Spencer, and Sanches Sosa (1975, p.5) reported that incentives for completion of work on time or in advance increased the students performance in the course.

A third criticism is the concern for students entering a new course is a negative attitude. Because of initial student apprehension towards a personalized instructional program, many students do not develop the sufficient desire to continue learning the material upon completion of the program (Couch, 1983, p.6).

A fourth criticism is that there is a lot of preparation time that goes into any Personalized System of Instruction program. As Couch (1983, p.7) stated, "educators...will find that the development of materials, tests, etc., takes an inordinate amount of their time.

A fifth criticism is that the Keller Plan is based upon Skinnerian conditioning. The criticisms of Behaviorism itself can be in turn applied to PSI (Couch, 1983, p.8).

A sixth criticism is that the Keller Plan decreases human interaction. As Couch (1983, p.89) states, "...instructors might feel alienated from their own courses after setting them up to run without the need of lectures."

A seventh criticism came from Keller himself. He stated that the administration may object to a new system that allows the instructor to "escape" their lecturing responsibilities (Couch, 1983, p.9).

A final criticism is that "Grade-flation" will most certainly come up as a controversial point (Sherman, 1976, p.4). This refers to the fact t students who complete a Keller course generally receive an A for completing the course, or do not complete the course or get a grade.

There are many responses to these criticisms. In response to the criticism that there is not a positive attitude entering the program, proponents state that if the Instructor makes an effort to be positive and enthusiastic towards the course, this enthusiasm will carry over to the students. By the time they leave the course, this initial negative attitude that a student might have had will be long forgotten.

The criticism that there is too much preparation time is answered by the claim that there is equal time gained in the course. Grasha (1977, p.4) wrote: "In trade for the initial time-investment, time will be freed during the course from lectures and demonstrations."

People in support of the Keller Plan, interestingly enough, responded to the accusations that PSI was based on Skinnerian By claiming that Behaviorism is part of education and should be a part of PSI. For instance: "This attitude (negativity towards PSI based on Skinnerian principles), however, overlooks the conditioning nature of education, regardless of the type of instructional technique utilized" (McGraw, 1975, p. 12).

The debate over the effectiveness of Keller's Personalized System of Instruction, with its advantages and disadvantages has been a predominant theme in the literature on Individualized Instruction for the last 25 years. There are indeed instances where a Personalized System of Instruction would be more beneficial than a conventional lecture class. This would apply especially to classes in which enrollment was high, course material was standardized, and faculty resources were scarce. On the other hand, when there is not a shortage of faculty, and the class is not a high enrollment class, the course would better be taught with more conventional methods, yet still based on sound educational principles.

Computer Assisted Instruction

The potential for computer assisted instruction was realized long before the home computer was technologically possible. It is difficult to say when CAI was first developed, but there are some early examples of it. The potential for Individualized Instruction through CAI was realized by John E. Coulson. He pointed out this potential in the article, "Computer-Assisted Instruction and Its Potential for Individualizing Instruction" (1973, p.3). Coulson wrote: "A modern computer has characteristics that closely parallel those needed in any educational system that wishes to provide highly individualized instruction."

The benefits that Coulson (1970, p.3) saw from the computer were:

1) "...it has a very large memory capacity that can be used to store instructional content material or....to generate such material,
2) "The computer can perform complex analyses of student responses by keyboard, punched cards, electronic pen, or other techniques into the computer."
3) "The computer can make decisions based on the assessments of student performance, matching resources to individual student needs" (Coulson, 1970, p.4).

Other benefits in the area of software that might or might not have seemed a possibility in 1970 include digitization of speech and video, work prediction software, alternative keyboards, and switches with appropriate software. Computer Assisted Instruction has come farther in dealing with handicapped and disabled students than possibly could have been realized at the time. These benefits and more were borne out later, yet for every advantage of a tool, one can usually find a disadvantage.

Some of the side effects of computer assisted instruction are stated by Henry F. Olds in an article entitled "The Microcomputer and the Hidden Curriculum'> Olds criticized Computer assisted instruction for its hidden side-effects. Some of these include:

1) "Learning is in control of some unknown source that determines almost all aspects of the interactive process. To learn one must suspend all normal forms of interaction and engage only in those called for by the program" (Olds, 1985, p.5).

2) "Learning is an isolated activity to be carried on primarily in a one-to-one interaction with the computer. Normal inter-human dialogue is to be suspended while learning with the computer" (Olds, 1985, p.5).

3) "Learning involves understanding (psyching out) how the program expects one to behave and adapting one's behavior accordingly. One must suspend idiosyncratic behavior" (Olds, 1985, p.5).

Some of these criticisms were answered later by Olds (1985, p.6) when he stated: "...time on-line needs to be mixed with plenty of opportunities for human interaction." and CAI should allow people to

"...jump around within the program structure...." These partially answer the criticisms about decreased human interaction and a lack of room for creativity.

Computer Assisted Instruction is quickly becoming the forerunner in Individualized Instruction. As home computers become more powerful and less expensive, the possibilities grow larger and larger. However, many of the criticisms will not go away with improved technology. There needs to be an improvement in the design of the software used, as well as an improvement in the methodology used to implement computers into education, specifically in school reform. Computer Managed Instruction through Instructional Development is the most recent trend in school reform. It addresses the need of school systems and offers solutions through instructional development. an analysis of the learners, the environment, economics, and instructors is conducted to best prescribe a program that will match the needs of each individual situation.

General Critiques

Critiques are usually focused on one particular variety of Individualized Instruction. Frequently, however, they focus their attack at the broader concept itself. While the characteristics of Individualized Instruction that are criticized are generally applicable to all types of Individualized instruction, some are not. Responses by the different strands of Individualized Instruction whom the criticism does not apply are abundant. They are quick to point out to the critics that not all individualized instruction is lie this.

The article "Individualization: The Hidden Agenda", by Ronald T. Hyman is an example of one such critique. What Mr. Hyman is concerned with are the latent functions of Individualization. He is aware of and gives examples of two of the manifest function, the segmentation of material and student self-pacing. He criticizes the segmentation of material by writing "Segmented Junk is Still Junk" (Hyman, 1973, p.2). His point is that in the push for individualization, many peoples definition is to divide the subject matter up into segments and teach it at a self taught level. There is no concern for what is really the problem, and that its the subject matter itself. He claims that what individualization does not do is to alter the subject matter based on the needs of the student. Without doing this, there is a compromise of Individualized Instruction. The concept of individualization that he offers should be concerned with releasing the potential of the student. To do this, there must be an "...emphasis...on who the pupil is, what he can become, and how he interacts with people and objects around him" (Hyman, 1973, p.4).

Other criticisms that he has with the current usage of Individualized Instruction are:

1 "Individualization...maintains the status quo. The power and authority of the teacher are key aspects of the status quo" (Hyman, 1973, p.5).
2) "With the isolation of the pupil comes the loss of group camaraderie" (Hyman, 1973, p.5) stemming from #2 above are:
3) a loss of "...the very essence of democracy...the feeling of responsibility to our fellows" (Hyman, 1973, p.5)
4) "...the loss of group interaction leads to the minimizing of peer teaching from which, both peer teacher and student would benefit" (Hyman, 1973, p.5).
5) "...the loss of interaction that results in class discussion" (Hyman, 1973, p.5).

He goes on to claim that in order to complete a course in Individualized Instruction, a student must be able to study alone, follow directions, remain quiet, listen, and follow orders (Hyman, 1973, p.6). If he succeeds he is quiet, docile, subordinate, and dependent. Ironically, these are some of the issues that individualization is supposed to address. He then claims that schools pre-adopt children to the industrial bureaucracy by preparing them to work alone and follow orders (Hyman, 1973, p, 6).

Unfortunately, this attack was too broadly based, and therefore many of his criticisms, including the loss of group interaction leading to less peer teaching, when applied to PSI for instance, would not hold. For in the Keller setting, one of the main methods of instruction and feedback is peer-tutoring.

The main point to be made was not lost, however. He prescribed that teachers must vary their teaching techniques from small groups to one-on-one work to large lectures, based on the needs of the students.

Conclusion

Individualized Instruction comes in many forms, from Audio-Tutorials to Computer Assisted Instruction. There are many common themes among them. Foremost of these themes is the effort to improve education, The principles that Individualized Instruction is built on, regardless of specific type, are the same principles that all of education is built on.

Even if all of the principles that are part of the theoretical construct of one of these types of Instruction are sound principles, this is not to say that the principles of the Individualized Instruction are all of those in Education. Because not all of the underlying principles of Education are addressed, group interaction for example, Individualized Instruction has its limitation. This fact must be realized in order for Individualized Instruction to be improved.

Each type of instruction addressed the effort to improve with a different set of prescription. All have been heavily criticized, yet that is to be expected. As Henry Olds (1985, p.2) put it "Most schools are still unsure about acknowledging the reality of the hand calculator as a tool..." Change is a slow process, how long did it take for the calculator to be accepted in schools? With every innovation comes resistance to change, and rightfully so. It would be foolish to incorporate every new idea that came into the schools within a year of its inception. If something cannot withstand criticism then it should not be a part of the school system.

Individualized instruction is still a relatively recent innovation, and will remain under scrutiny until several criticisms are accounted for. Resistance to change will delay the implementation of these innovation, even after their limitations are accounted for. Individualized Instruction will then carry out its proper role in the improvement of education.

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Title:

Too Much Too Fast: The Dangers of Technological Momentum

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For this discussion, technological momentum can be defined as the increase in the rate of: 1. the evolution of technology, 2. its infusion into societal tasks and recreations, 3. society's dependence on technology, and 4. the impact of technology on society.

Some may not like the use of the word evolution in relation to non-living things. Technology changes due to environmental stress, responding to needs or wants in society. Changes in existing technologies try to alleviate this stress. This fits the concept of evolution well, so that word will be used. Infusion is the use of and reliance on technologies by persons in the course of completing tasks or pursuing recreation where technology was not used before.

The use of the word technology should also be addressed. Technology can be looked at as either a process or a product. Although the first may be considered by many in the field of instructional technology as the more proper way of thinking, popular usage of the word has given the second as much or more weight. When technology is used to mean only a product, I will use the word product or hardware, which will mean both hardware and software for the remainder of this paper.

There are two facets to technological momentum. The first is *too much* technology. The second is gaining technology *too fast*, without fully understanding the impact that the technology will have. There are inherent dangers in each that technologists, instructional technologists in particular, need to take into consideration as they advance technology's influence.

Why do criticisms of technology exist? Is change bad? Is less work for the teacher bad? This paper is an expression of worry, fear, or concern dealing with a perceived flaw in something. Sometimes the criticism is constructive and meant to lead to the correction of the flaw. Just as often, the flaw is used as a reason to disregard or discredit the thought or product it is contained within.

Instructional technology has been talked about as a panacea for the ills of education and society in general. Not all, however, look upon instructional technology with favor. Many are opposed to the use of technology within education. Others, even educational technologists, oppose the way in which technology is currently used. Several of these criticisms focus on the idea of technological momentum.

It is often easier to identify problems from the outside of an issue. People not intimately connected with an issue can be more objective. This makes it important for insiders to listen to them. They often provide insights that no insider would generate.

Instructional technology is a part of technology (Heinich, 1984). It follows from this that the dangers and criticisms of technology in general are also valid for educational technology. This is of great concern to educational technologists. We must not only be aware of what we are doing, but also what people in other fields and disciplines are doing as well. In the public's mind, all technology is part of the same machine. All parts of the machine bear the blame when one part fails to work properly.

The fact that technology is gaining momentum is very easy to see when you look at history. The Stone Age, Bronze Age, and Iron Age have chronologically dominated humankind's history. Many significant advances were made during these periods. However, significant advances, such as the wheel and printing press, were few and far between. Changes in thinking or design were slow to develop and just as slow to spread.

Not so during the Industrial revolution. Complex, automated machinery began to be used. Society began to change from a rural, agrarian base to an urban, industrial base. The steam engine gave power previously undreamed of, making possible the steam locomotive and cotton gin, to name a few. The development of the assembly line ushered in a new age of industrial technique. Change followed change, each new product developing further or leading to new side-products.

In the 1970's, aproximately 200 years after the start of the Industrial Revolution, the world's dependence on oil and other fossil fuels was shown when OPEC imposed an oil embargo. This forced the United States and other countries to look at their use of oil-based and oil using products. In a relatively short period of time, society had developed and become dependent on such things as the internal combustion engine and plastic.

In the 1950's, the first super computers were shown to the world. They filled entire rooms and could follow only very limited instructions. In the 1970's, a scarce 20 years after their introduction, computers became small and inexpensive enough for personal and office use. In 1984, Apple released a computer that used a new idea, the graphical user interface (GUI). GUI provided a visual, intuitively understood way to communicate with the computer. Now, in the 1990's, nearly every college faculty and a good deal of the population at large has a computer a thousand times more powerful than the 1950's versions sitting on a corner of their desk. We are joined to each other around the world by invisible communications systems that can provide nearly instantaneous access to information stored almost anywhere in the world. We are now in an Information Age, but for how long?

Changes have become exponential as time goes on. Each new development breeds more new ideas. From these ideas spring forth even more ideas. On and on it goes, and *whether* it stops, nobody knows. Changes in early technologies were simple, often being a change in material or design. The Industrial Revolution saw the widespread impact of a different type of technological change, a change in the *way* something was done. Since then, the rate of change has grown exponentially. Hardware changes much more quickly than the thinking and concepts behind them, but both are changing rapidly even now. New hardware is often obsolete within five years, less with computers. There is an incredible drive for change within humankind.

Technology is often associated with the pursuit of progress, doing more things faster. As society changes, its needs change. The changes in technology are often responses to these needs. Sometimes the new technologies or products lead to the change in society's needs instead. Technology is a means to the end of progress. However, it should be remembered that progress is not always good.

The development of the cotton gin revitalized a crumbling slave-based economy in the South. In order to supply the world's need for timber and beef, we are cutting down enormous tracts of rainforest every day. Entire species and cultures are becoming extinct so that we can grab a Big Mac© at the drive-thru on our way home so that we don't miss our favorite television show.

What are we driving home in? An automobile powered by gasoline. What is gasoline made from? Gasoline is but one product that we get from petroleum, along with heating oil, rubber, adhesives, solvents, and plastics. In our need to keep all these machines going and make more of them, we drill into the earth in more and more places. Each drilling site upsets the natural balance of the immediate area. When oil spills occur, it upsets the balance over a wide area. Even more hazardous is the fact that oil spills destroy large amounts of plankton, the small ocean plants responsible for ninety percent of the earth's breathable oxygen. The strip mining that occurs to support the manufacture of products and the chemicals we make further damage the biosphere. As we use more and more machines, for more and more functions, these atrocities will grow. They are of great concern.

Remember that technology doesn't just respond to changes in society, it can drive those changes as well. The microwave oven is one of those products that has changed our lives greatly. The microwave oven was developed in response to the needs of the space program. It was only one very small part of the complex system required to put humans into space. Once it became available to the public, however, it became a focus of American cooking. No longer must we wait for our food. Preparation time has been drastically reduced, freeing time for other pursuits. Individual portions are more easily prepared, making large family meals a less frequent occurrence. Society's need for speed is spreading into all parts of our life. How long until it reaches our educational system?

There have been changes in our chosen forms of entertainment, too. Radio was the first non-written entertainment to enter people's homes on a wide scale. For the first time, large numbers of people could be reached at the same time over great distances. This was even more true of television, when it was introduced. At first people only had to choose between one or two radio or television stations. As their popularities grew, there were more and more stations. This meant more and more choices. Now, with cable, it is not unusual for there to be a choice between 30 or 40 channels, each with something slightly different, each competing for people's interest.

This competition for interest has become a race of who can have the funniest, saddest, most real, most exciting, or even bloodiest programming. To keep our attention, plots change rapidly. This has caused a noticeable drop in attention spans in students who are part of the "MTV Generation." Surely an unplanned for side-affect, but still a result of the rapid change in television.

Criticisms of technology have been around for a very long time. Mary Shelly's *Frankenstein* addresses the issue of humans losing control over their creations. Dr. Frankenstein seeks control over life and death itself, he wishes to create life. He is even successful, bringing to life a conglomeration of pieces from corpses recovered from the graveyard. Having found the secret to giving life to a being, Dr. Frankenstein only realized that he *could* do such a thing. He did not stop to think whether he *should* instill life where there is none.

These questions remain today, even with the above example. Cloning is a cutting edge field. Even today, court cases rage over the question of artificially prolonging a person's life through the use of machines and drugs. What medicine can do today would seem almost as wondrous as creating life to someone from just 250 years ago. In some instances it can be a very helpful thing. In others, it is unwanted and is hated. Many people believe that not everything can, or should, be controlled. This may be even more true in education than in other parts of society.

Control is a necessary part of technology and instructional technology. Control is needed over outcomes, procedures and evaluation. Without this control to define, the instructional technologist will fail in designing an effective system. It is only when variables are eliminated or successfully manipulated that control can exist. Only when control exists can instructional technologists design an efficient system. However, control is something we are taking away from the teachers and technologists. It is being given to the students in the hopes of involving them in their own education, individualizing each student's education, and making each student's education relevant to their life. Without control over these things, are technologists going to be able to plan instruction usable by everyone?

This need for control is a limiting factor for instructional technologists. Certain subjects, like mathematics and physical sciences, lend themselves to the rational, logical organization that is the hallmark of instructional design. Not all subjects or outcomes fit in so nicely, however. It is very hard, perhaps impossible, to put attitudes, creativity, and understandings into behavioral objectives, another hallmark of instructional design. A problem of instructional technology is that objectives are often changed when instruction does not lead to the desired behavioral changes (Merrill, 1971).

> ... we adjust *what* we teach to what we *can* teach in a certain way, rather than adjusting our teaching to the human being. Though we all look forward to the day of more use of educational technology in freeing the teacher from tutoring, reviewing, drilling, and evaluating, we must also recognize the danger of de-emphasizing the development of children's imaginations, of creativity. (Driscoll, 1978)

This passage both praises instructional technology and warns against its use. The benefits of increasing technology in the schools are many. But will we limit our instruction to only those things we can control and define?

Most educational technologists don't design systems or instruction that they don't want used. These systems are used by people. The systems involve people. Therefore, the concerns that people have with technology and instructional technology in particular should be taken into consideration. As peoples' concerns with technology grow, so will their dissatisfaction with the educational system.

One of the major criticisms of instructional technology is dehumanization. There are certain characteristics that are regarded as being "human." Among these are creativity, feelings, compassion, individualism, passion, and understanding. When something other than a human possesses one or more of these traits, it is often personalized or given credit for being like humans. If a person shows a lack of these traits, they are said to be mechanistic, cold, or inhuman. There is a great deal of importance given to these traits, and anything that hinders or retards their development or expression is considered undesirable.

One of the greatest of the dehumanizing arguments is that technology seeks to treat every person the same way, disregarding individual attributes, abilities, feelings, and needs. Individual needs are only met when they meet the demands of the system (Streibel 1986). As the use of technology in education increases, there is the danger that students will be treated less as the individuals they are and more like interchangeable parts.

The students lose their individuality. They are treated as another variable in the system. This student-as-product ideology has been a major criticism of instructional technology. The concept of people as parts is offensive to many educators. This can make instructional technology very unpopular to the average educator.

Educators are also in danger of becoming interchangeable parts in the instructional system. The purpose of instructional design is the identification and manipulation of individual variables in the instructional process. To many instructional designers, teachers are just another variable. Individual teacher characteristics are disregarded. One teacher becomes just as good or as bad as any other teacher. The craft, or art if you prefer, of teaching will be replaced by the competency of teaching.

Bates writes of a cult of competency. It is described as "one current mechanism through which certain changes are being advocated in the professions and their associated education programs." The cult of competency is not an educational movement, it is a managerial movement with the goal of increasing efficiency between differing sections of society. The effect of this movement will be the deterioration of teachers' skills. (Bates, 1992)

> The overall result of the cult of competency, paradoxically, is likely to be a system that may well serve to restrict the development of expert professionalism, ...In constraining the open-ended nature of professional activity at this expert end of the scale we may well produce a competency based system in which substantially more professionals' performance will be reduced to the level of basic skills. We may well end up with the

> very thing we do not want: professionals in education as elsewhere who are indeed barely competent. (p 7)

If teachers and students are reduced to interchangeable parts, another phenomenon will occur. The skills required, both by teachers and students, will be reduced to the barest technical levels.

As teachers are encouraged to adopt new technology, they will also have to adopt new roles and duties. Teachers will become interchangeable since their skills will be at a minimal mechanical competency. (Koetting, 1988)

> As the teaching profession has become an increasingly highly skilled technology with a primary emphasis on methods and outcomes, teachers have been rewarded for guiding their practice in ways amenable to their technology. As Macdonald suggests (1975), this notion implies that "teachers are potentially interchangeable," and leads to viewing productive activity as something learned and performed "mechanistically." Thus, any "good" teaching activity can be reproduced by any other teacher, and "...all productive teaching is measurable in terms of the criteria of the accountability in use"(pg446)

Diversity is an important idea today. Awareness of and appreciation for the differences among people is a focus of many educational reforms. It is the current theme for Kappa Delta Pi, an international educational organization. Tolerance for differences is not only a goal for our students, but for today's teachers as well. The accommodation of learning style and cultural differences is increasing its importance as an issue in teacher preparation programs and continuing teacher education. A result of this effort is the formation of a single global community. The idea of a diverse community is at odds with a technological approach to education. The conformity that is forced by designed instruction works to inhibit individual differences.

> Coupled with this faster rate of societal change will be an increasing homogenization of different nations and cultures. As the centralization of production grows, instructional units will become ever more standardized; whatever cultural differentiation takes place in programming to adapt to different audiences may be as much 'window dressing' as actual. This growing uniformity will speed the rate of global change and facilitate intercultural communication, but will also reduce the pool of diversity and pluralism on which the human race can draw. (Dede, 1981)

Technological advance is based on control and uniformity and being able to predict outcomes. Even as we begin to preach about the community and diversity, we advance the technology that may very well destroy these traits within us.

Adapting to new technology will become easier as time goes on. Speaking of a popular piece of technology, McPherson writes, "The more adaptable computers become to the requirements of human beings, the less human beings will have to adapt to the requirements of computers" (McPherson, 1984). The Macintosh's graphical user interface made it much easier to use computers. You no longer needed to know commands and codes that sounded and looked like Greek. This ease of use resulted in an increased use of computers in many areas: home, business, and school. Now, hardware and software exist that can recognize an individual's handwriting and convert it to type. The addition of speech recognition and vocal control to computers will make computers even easier to operate. Soon, we will be able to talk to our computers on nearly the same level as another person.

The fact that technology is becoming easier to use leads to its increased use, whether it is needed or not. "A common, and often justifiable, criticism of instructional design is that it results in doing better what shouldn't be done in the first place" (Gustafson, 1971). Again, just because something can be done, does not mean it should be done or will have positive results.

The preoccupation of instructional technology with management theory and efficiency are often seen as weaknesses. It is not that educators are against efficient instruction, it is the degree and manner in which instructional technology uses these ideas.

The managerial approach of instructional technologists includes the students-as-products idea. This idea is disliked by many educators. The idea that students are components that move through the educational system, each being treated in the same manner, doesn't coincide with the view of teaching held by many educators. For many, teaching is an interactive process. This interaction is primary social interaction between individuals or groups, i.e. other people. While instructional technology strives for interaction, it is interaction between people and machines. Replacing people with machinery is a very dangerous proposition. It is, however, the direction instructional technology is heading.

The increased use of managerial models in instructional technology relates to the control issue as well. As more technology is used in the classroom, educators at the local levels lose more and more control over what is taught and the method of instruction.

The control of instruction will mirror the change in control of production. (Bates, 1986)

> ...the development of industrial capitalism was based not so much on technical advances in production methods, but rather upon alterations in the management practices which removed control of the production process from the hand of artisans and relocated it in the hands of owners. Simultaneous with this process was the deskilling of the workers. (pp 4, 5)

Again, the history of general technology can be used to foretell the future of educational technology. Just as control of production was taken from the workers, so too will the control of instruction be taken from teachers. The control will rest with the instructional designer, who is often far removed from the classroom environment.

There is also the change of roles for educators. Educators will stop being deliverers of instruction and become managers of instruction. (Bates, 1986)

> What teachers may well be experiencing...is an intensification of pressure to conform with particular instructional models which are determined by researchers as "more effective." Principals and Instructional Leaders of various kinds are likely to be subject to increasing barrages of information on "successful" instructional techniques and be urged to ensure their adoption by teachers. Systems of sanctions and rewards (incentive systems) will be introduced to reinforce the adoption of the new techniques and to engineer a political apparatus of regulation which will parallel the particular organization of the tasks of educational production specified by the experts.
>
> Such developments are likely to lead both to an increasing emphasis on the logic of bureaucratic rationality (Rizvi, 1986) and to further restrictions on the responsible autonomy of the teaching profession. It may well lead to further development of what Webb (1985) calls status panic among teachers. Moreover, such developments are certain, in my view, to further develop a technical notion of educational practice which is devoted to managerial rather than educational ends. (pp 11,12)

Again, the switch to managing instruction eliminates much, if not all, of the interpersonal relationships that educators take pride in. Part of teaching has always been the challenge of communicating with the students, passing knowledge, skills, and thoughts to a new generation. Instructional technologists would reduce the complex interpersonal interactions to a cold, sterile overseeing of instructional tasks. Are we promoting an educational system where the terminal degree is an MBA, not an MSEd?

The fact is, technology is coming on too fast. Educators can't keep up with the rapid change taking place. Most schools don't have the knowledge necessary to integrate technology effectively into their system. How often, even in higher education, do we see brand new equipment sitting in an office or a lab, unused? Often, people simply don't know how to use the new products or methods. The tremendous advances in technological capability has not been paralleled by advances in training or ability at the level of our schools. Often, even our teacher training programs lack such instruction.

Schools often find themselves at the mercy of distributors and companies who want to make a profit. Administrators, School Boards, and teachers often purchase instructional materials or hardware that never get used. When methods or hardware that don't work are acquired, what is the solution? Apply more technology, of course. (Nichols, 1987) If a product or method doesn't work, it can be made to work if enough time and money is spent on making it work. The idea that another product, or even no product, could do as good or even a better job infrequently comes to mind.

Technology often breeds the need for more technology. Usually, the new technology is designed to overcome problems of or solve problems created by older technology. There is always the drive to do more, to do it faster, and to do it less expensively. This is a very dangerous idea. Take for example the technology of war. Each invention was never good enough at killing. Sticks and stones became swords and bows. Then guns and cannon were developed. Next came explosive shells, then missiles. Finally, the nuclear bomb was developed. Were designers happy? No, they wanted even more destructive power. Where does it stop? Now think about this trend in relation to education, where will the instructional designers stop? Will all behaviors and actions be reduced to pat little formulas? Will every aspect of life become an equation?

The concerns stated in this paper are just that, concerns. They are not condemnations of technology. Technology has many advantages and is here to stay. We will not get rid of technology. Nothing we do will stop the evolution of the processes and products that are becoming integral parts of our society. Even if we could stop technological momentum, it would not necessarily be a good thing.

There is, and will always be that within humankind that craves and needs change. There is also that within humankind that fears change and will try to stop it. Envision the process of change as a river. The fear that inhibits change is a dam across that river. The pressure of the river builds and builds behind the dam. Finally, the dam breaks and there is a massive rush of water. Only for us, it is change. This power can be harnessed and used for productive purposes, just as a controlled flow through a dam is used to create energy. If it is held back for too long, though, it will eventually burst through, carrying us along whether we are ready for it or not.

We should try to direct and harness the power imbedded within technological momentum. The benefits that can be gained from technology are many. However, uncontrolled advancement will cause more harm than good. We need to listen to the concerns brought to us by the public, by educators, and by our peers. Let us address the issues facing us. Let us become ethical, responsible practitioners of instructional technology.

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Title:

Dehumanization: An Overview of Educational Technology's Critics

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Almost since its inception, the work "dehumanization" has caused many to feel apprehensiveness, especially as the words relate to Educational Technology. Like "human engineering", dehumanization carries a stigma of Orwellian proportions which is not likely to dissipate. This phenomenon, as it relates to the field can be traced back to the turn of the century, or possibly even further. We have witnessed a revolution in classrooms since those days, from one room schoolhouses to giant city and metropolitan school districts. "The building of technologies have made it possible for people to cluster together in huge numbers in urban centers where they live a segregated kind of life which no one notices-not segregated according to black and white, but segregated according to income bracket" (Taylor, 381).

Some would argue that the implementation of new technologies is recent years has caused us to forget our own humanity. "What is good must have accountability, must have behavioral objectives; in effect must be efficient" (Meierdiercks, 8-9). This paper is a brief analysis of Educational Technology's critics from the late 1950's through the present time. It also serves as a brief study of how their rhetoric has affected the structure of the K-12 classroom in recent years.

"The emerging era of high technology has made its promises that life will be easier and its problems more easily solved. The result of this slow but persistent change has been a shrinking concept of education as we have looked toward a concept of "training" rather than education" (Nelson, 9). When looked at in retrospect, it is truly astounding how much technology has influenced each of our lives. More innovations have been developed in the last 58 years than in most of recorded history. "as time passes, technology multiplies in staggering exponential terms" (Smith, 3).

The fundamental problem addressed in this paper, however, does not concern itself with technology's rapid growth exclusively. This is mainly because, its growth, for all intents and purposes, is simply a factor, capable of neither good nor bad. It is the importance we attribute to certain things, however, which gives them their intrinsic value in our daily lives. Technology, then, as it pertains to education, is certainly no exception. According to many critics, the variable of technology which once seemed so promising, has fallen from use into abuse in recent times. It is this abuse, they contend, which has served as a catalyst in aiding dehumanization in the K-12 classroom setting.

The Sixties: Revisionism, Objectivity and the Teaching Machine

The decade of the sixties opened with a continued emphasis on hard sciences and objectivity in the American curriculum. While records, tapes, and film continued to gain popularity in classrooms, many teachers struggled to maintain a sense of individuality both for themselves and for their students. Some of the era's new inventions, which would now be considered novelties, posed a valid threat to teachers who were uncomfortable with technology's implementation in the school environment. One such innovation was a clever little devise created in 1962 by Kobler and Moore. It was know as the talking typewriter, and although it was quickly phased out as a passing fad, many students took a quick liking to it.

Harold Taylor, in his 1964 address to the DAVI Convention stated that technology has often been a key factor in imbalancing our values as a nation. In essence, Taylor surmised that America had become "a society which is as dazzled by technological accomplishments as it is powerless to act on the most serious problems created by them" (Taylor, 382). During that time period, it appears that many of Taylor's comments were not terribly far from the truth of the situation. He saw no needs or incentives for students to stay in schools that were quickly becoming (as Herbert Kohl once defined them), "grim, joyless places."

Taylor was not the only critic who harbored this revisionist attitude toward modern education. In later years, other personalities emerged to stress the need for increased humanity in the system. "One might add that the future would take on profoundly different meaning if the revisionist's vision were to prevail." Bowers was also quick to not the "symbolic fragmentation and increasing loneliness that appears to result from the low-context form of modern, technologically-based cultures" (Gowers, 280).

Nevertheless, many in education continued to look at technology through rose-colored glasses, and the many education possibilities it seemed to promote., Interest was even re-kindled in old educational devices, some of which had been operationally dormant for 30 or more years. One such instrument was Pressey's teaching machine, which distributed rewards (such as candy) for correct answers to questions. This renewed excitement in objective theories helped to put psychologists like B. F. Skinner back in the education spotlight.

His 1968 book, "Teaching Machines", chronicled his use of conditioning upon common pigeons, and the results he received. Though it was simply a collection of his old essays, its wild popularity seemed to indicate that schools were not ready, or particularly fond of moving away from behavioral objectives.

The Seventies: CAI, Educational Television, and Resistance

The seventies became a witness to large scale computer experiments, CAI, reading instruction, cable television, and intensified individual instruction. Readi Television, was, by this theme, a powerful and well-integrated tool for both elementary and secondary education. Shows like Sesame Street and the Electric Company became popular in the curriculum for students around the ages of 7 through 10. Films, filmstrips, tape recorders, and phonographs became a mainstay in seventies classrooms. Though the personal computer was still in development in the early seventies, the excitement had already begun over their eventual implementation.

In 1972, Nila Banton Smith cited three fundamental problems with technology in regard to its use in education: Cost (4 to 6 million at the time), resistance, and most notably, its dehumanizing effect. "A controlled study recently made with 'junior high school students at Stanford University indicates that computers are more charismatic then teachers" (Smith, 12). Though Smith cited this as a potential problem, she also indicated that it was perhaps better for the students to make a "truce" with technology rather than resist it. This "truce" could generally be thought of as a compromise between the learner and the inevitable advent of the impressive machine.

Eric Hoffer was once quoted as saying that "We never can be fully prepared for that which is new. We need to adjust ourselves, and every radical adjustment is a crisis in self-esteem...it needs inordinate self confidence to face drastic change without inner trembling." But for many educators during the seventies, the inner trembling had already begun. For some, the threat of new technology only served to compound their struggle to teach a given curriculum. "When technology is added to the traditional classroom, in many cases, the addition is simply another overlay of administrative, managerial detail" (Evertson, Stallings, 58).

John Belland also took note of this phenomenon examined some of its inherent problems in his 1975 essay, "1984 is Only Nine Years Away: Will School Media Programs Humanize or Dehumanize Schooling?" again, images of Orwell are conjured up for the reader's consumption, as Belland confronts the man-machine controversy directly. In his essay, the author makes it quite evident that the choice of whether to humanize or dehumanize rests solely with the human race. "We are faced with the very real question of whether the technology which has been evolved by human beings to meet human needs serves to liberate us or serves to enslave us" (Belland, 3). Furthermore, Belland contends that media are simply extensions of people, and that technology should be policed to insure that they remain that way.

Systems Analysis and Individualized Instruction-Continued

Systems analysis was one of the many controversial trends that surfaced during the 1970's. Though the sixties saw much of the advent of this instructional technique, the seventies helped to saturate the process and make it an integral part of the overall curriculum. At the time, it may have seemed that the term "individualized instruction" implied a more student-centered approach. Some critics, however, regarded it as nothing more than the complete antitheses of its name.

> In any case, such a concept of individualizing hardly meets the demand to personalize the school, for critics are aiming their attacks at the content taught as well as the procedure for teaching it. Obsolete or irrelevant material learned in small segments is no less obsolete or irrelevant. Segmented junk is still junk (Hyman, 414).

In addition, Hyman concludes that individualized instruction contributed to loss of classroom interaction, discussion, peer conferencing, and other related schoolroom activities, The focus, according to Hyman's reasoning, should be on content rather than procedure. This sentiment was shared by other critics of the period, including John W. Alden. It was Alden's argument that educators of the seventies were unable to take technology and apply it in a way which was beneficial in promoting learning among students. "I believe that we are so enamored with techniques, particularly when they are computer related, that we often lose sight of the reason for the technique in the first place" (Alden, 3).

Many agreed with Alden's views during the seventies, and noted that systems analysis had not its focus as an interlocking program. The human element of the process was slipping away, with technological momentum gradually taking its place. Overall, the general attitude persisted that educational institutions were producing students who were merely meek repeating machines. "Most educators would not like to hear students described as meek; but received, memorizing, and repeating would hardly raise an eyebrow" (Christenbury,5).

This submission of man to machine was something that continued to both fascinate and disturb critics during the seventies. Kenneth D. Benne, in a 1975 article, outlined some of the dehumanizing trends he saw inherent in the modern day educational system. "Schooling is seen and practiced as a process in which "correct" environmental influences, predetermined by adults, are brought to bear upon assuredly passive and plastic learners to produce educational "products" needed by society (Benne, 45).

Unlike more conventional-minded educational technology critics of his time, Benne took a more creative approach to analyzing the situation by writing a poem. In it, he personifies technology as an overwhelming deity which had awestruck it followers to the point of nearly complete submission:

> Faceless or whith averted faces, I stood alone and I could hear
>
> Their almost human voices-impressive sound
>
> Well amplified, most high-fedility-commanding "Kneel!"
>
> I did not kneel. And from me came a bleat-
>
> Most poorly modulated low-fidelity- "I do not feel your right to make me kneel.

This deity, by the end of 1970'2, was certainly a force to be reckoned with, especially in regard to teaching. The teacher's and was continuing its demise. "Teaching related issues appear not to be taken very seriously; issues such as individual philosophical orientations and their reasons for being a teacher" (Jorgenson, 264).

Ken Meierdiercks, in a 1980 article, noted technology's ability to swallow virtually anything that stands in its was. "Our technological society is much more dynamic and devouring than any other in history (Meierdiercks 8,9). By this time, society had, in many ways, become the technological future world which George Orwell had boldly envisioned.

The Eighties: Militarization, Computers, Vocabulary, and Science

Militarization

The repercussive embers of Sputnik remained evident throughout the eighties, as critics continued to evaluate how well the educational movement's long term goals were met. During the 'Reagan Administration, there was an attempt to hold military funding to a more militaristic standard. "In order to improve instruction and in order to legitimate their profession through the incorporation of new technologies and the latest applications of scientific research, the schools have unwittingly welcomed the Trojan Horse of military prerogatives within their gates" (Nichols, 182).

The teacher, in a sense, is regarded as the unassuming victim of this abrupt technological invasion. The "microcomputer phenomenon" which began in the eighties and continues to this day is viewed by Noble as the "most visible" symbol of educational dependence. In other words, the very military which helped develop computer science was now helping to dehumanize the educational school process. "To the degree that our purchases are less professionally conceived activity attending primarily to education, and more a social imperative connected to economic, political or military gain, our buying hardware can be called negative" (Nichols, 128).

Meanwhile, teachers continued to feel their influence waning as they too became slaves to the powerful forces of Educational Technology., This problem, as it relates to the study of language arts was recognized and commented on by J. Amos Hatch in 1984. "Teachers look and act like instructor-technicians as they teach reading. They march their students along the reading system and instructional management assembly lines using timetables, materials, and strategies prescribed by invisible decision makers" (Hatch, 248).

Many critics found this trend particularly unnerving because it tended to discount the very art of teaching itself. Individual teaching styles, as well as knowledge of pedagogy became incidental when compared directly with facilitation skills. Part of this downward spiral, according to Hatch and others, could be attributed to Educational Technology.

Kathryn Nelson, in her 1985 paper, "Liberal Arts in a High Tech World", a retrospective portrait is persented of a world whcih has seemingly become devoid of humanilty and true liveral education. "The society suffers from a loss of skills for living, a loss of humanity and a growing lack of skills for dealing with a gloval society, a chinging world for managing technology and deciding whether it will be master or slave" (Nelson, 10).

So far, it is Nelson's contention that society has opted for the role of slave., Learning has witnessed a profound shift from "classical education" to a process of mere training. As a result, many lack basic reading, cognitive, and spelling skills upon graduation from high school (Nelson, 7).

Vocabulary

It is certainly no secret that educational technologists have their own jargon, much like any other field or discipline. There has been concern in recent years that the very terms technology uses, as well as the dialogue created, seems to isolate people from one another. Sally Jorgenson once conducted interviews regarding this matter with teacher education faculty at Indiana University, yielding some poignant commentary. "The interviewee also asserted that the machine talk, the technocratic language of IST is threatening, alienating, and totally unnecessary. " 'Humans don't talk like that,' he said" (Jorgenson, 268).

James Finn has also noted, in "Dialogue in Search of Relevance" that technology's very dialogue has helped create an atmosphere of "impersonal control over people."

Remedies for this particular ailment have not come easy, but Finn has offered one practical suggestion. "Unless we listen to what some of our bright young people are saying, to what the new left is trying to expound, to what some artists are expressing, we, as educators, may fail this country, and all the young people in it" (Finn, 143). Although Finn's critique was aimed primarily at the college educational system, many of his ideals appear relevant to the K-12 classroom as well.

Science, Technology, and Literature

Perhaps one of the least addressed aspects of technology as it related to education is in the area of science. Because technology is in such a constant state of flux, many of the new innovations developed through the fusing of these two related fields appear increasingly normal. The seventies and eighties brought the world a collection of art and literature brimming with science fiction and technology related themes. Authors such as Ray Bradbury (Fahrenheit 451), Michael Crichton (Jurassic Park), and Arthur C. Clarke (2001: A Space Odyssey) have carried on the literary tradition of Orwell by daring to envision the dangers of the dehumanized society in their writings.

While many interpret these pop culture opuses as mere pleasure reading, others have realized elements of reality apparent in them all. In 1987, Randy Nichols noted that Educational Technology has the possibility of mutating into new potential categories, such as Educational Bio-Technology. The proposed sub-field, as outlined in his article, sounds a great deal like "human engineering." "The key characteristic is physical invasion of the body, though psychological changes certainly occur also. Educational bio-technologists could consist of implanting microprocessors in people or giving food and drugs to people to change some aspect of their education" (Nichols, 128).

Some Conclusions

The critical research seems to indicate that there are no easy answers to the increasing problem of dehumanization that confronts us each day both in society, and in our K-12 educational system The monumental growth of technology as a field has brought many issues into question regarding our own humanity, literacy, emotions, skills, and educational experiences. The critics seem to indicate that the abuse of technology has caused a chaotic trend of dehumanization since the fifties, and educational standards continues to plummet.

The critics essentially have noted that technology is not an end in itself, and therefore, should not be regarded as such. Objectivity has all but replaced subjectivity in the curriculum, and learning has become a passive process rather than an active one. The acquiring of knowledge has too often been confused with rote memorization, drill and practice tests, and other devices which seem to stunt the cognitive and reasoning abilities which must be nurtured in students.

As a result, students have become the by-product of an educational hierarchy which establishes what will or will not be learned. This hierarchy has manifested itself in various forms, including high powered school administrations, big business, and most notably, the military. Though some have called for radical revisionism in the educational process, many indications seem to suggest that their attempts were futile. Poor interaction, discussion, and literacy skills are just some of the problems facing students as a result of this imbalanced technological structuring.

Fear, isolation, submission, and loss of teacher and student identity seem to be recurring themes contained in much of the critical theory concerning dehumanization. When examining the work of the critics as a whole, there seems to be no question that more research needs to be done in this particular area. Compromise between liberal education and technology is a start, but not a direct cure-all for the many complexities which dehumanization presents.

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Title:

Understanding the Critics of Educational Technology: Gender Inequities and Computers
1983-1993

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Although many view computers purely as technological tools to be utilized in the classroom and workplace, attention has been drawn to the social differences computers perpetuate, including those of race, class, and gender. (Campbell, 1984; Damarin, 1989; Huff et al., 1987) These differences are the result of a combination of many factors. Arguments have ranged from the view of computing as a culture to the content of the software that the computers utilize. This paper focuses on gender and computing by examining recent analyses in regards to content, form, and usage concerns.

The content of educational software packages has been critically examined to reveal partiality in their design (Huff and Cooper, 1987; Biraimah, 1989; DeVaney, 1993; Rosenthal et al., 1988; Benoit et al., 1991). This class of critiques encompasses differences in software design, concern for race, socioeconomic class, and gender stereotypes in the overall text of the software, and the lack of quality evaluation of educational software to identify gender bias.

Other research has focused on the machine in it's most basic form, and have shown that it has the same effects (Turkle, 1984; Damarin, 1993; Bush, 1983). These studies are rooted in the theory that microcomputers have been developed through mathematics and science, typically viewed as masculine fields. Therefore, there is an inherent bias toward male-dominated thinking. As a result, the way the user approaches the computer can have an effect on his/her success or failure.

Finally, the question of who is using computers and how they are being used has raised the issue of access (Campbell, 1984; Hawkins, 1987; Lockheed, 1985; Nelson et al., 1990). In order to ensure equity in microcomputer use, all students must have equal opportunity to learn about and use computers. While it may be apparent how differences in socioeconomic class would allow for these discrepancies in access, issues of gender become apparent upon examination when coupled with the fact that most computers were initially associated with mathematics and science departments. This has effected the way computing is taught, the location of the computers, the integration of computers into schools, and the uses of computers in the schools.

Content

Concerns regarding educational software content have been of interest since the incorporation of microcomputers into classrooms. While some practicing teachers may find it feasible to design software for their classrooms using a variety of programming languages and authoring systems, the reality is that most teachers have to use preexisting software packages. As a result, there is concern for the quality of this software, as well as the lack of appropriate means for evaluating and detecting gender bias. A sampling of the critics of software design methods will be examined first.

Huff and Cooper (1987) conducted a study regarding software and it's design. The purpose was to specifically test for gender differences in software designed by experienced educators. This exercise led to interesting results. Regardless of the gender of the software designer, there were differences in the programs designed for male, female, and a mixed class of male and female students.

The software designed for males was more game-oriented and action-based. The software which was designed for female students was more tool-oriented, reflecting their recognition of the computer as a learning tool. While this is consistent with other research of this nature (Turkle, 1984), what is truly shocking is that the software that was designed for the heterogeneous group was most similar to that designed for male students, i.e. game-oriented. What this indicates is that there is a perceived difference between the types of software that male and female students prefer by teachers designing software.

It is interesting to note that those involved in Huff and Cooper's experimental design were experienced classroom teachers. These are individuals expected to be concerned with the format of educational software in regards to interest groups and should therefore be most conscientious in their design.

The actuality of educational software design is that although the audience may be mixed, the programs are designed with male characteristics. There have been numerous studies which coincide with these findings (Kiesler et al., 1985, Hawkins, 1987). If the software being used in the classroom is designed with a particular sex in mind, and it is the "wrong sex" for the user, then anxiety level could rise and learning decline.

What Huff and Cooper have suggested as a possible solution is that software be designed that has game and tool characteristics so that it will be appealing to both sexes. This solution is a valid one, but it does not take into account the preexisting software which is being used in classrooms.

Karen Biraimah (1989) addresses the issue of content in prepackaged educational software in her article "Inequalities in Classroom Computer Software." She suggested that software, like texts, transmit knowledge, including values which are those of the designer. The problem with this model is that the software designer is usually a member of the societal majority. Due to this membership, students are exposed to stereotypes and values, with disregard for those who do not hold those Anglo-middle class male views. As a result of her acceptance of this concept, the author surveyed fifteen educational software packages. Her findings were congruent with related studies. (Benoit et al., 1991; Campbell, 1984; DeVaney, 1993; Rosenthal et al., 1991) The gender and ethnic under-representation which had been previously found in textbooks, held true in the software. Biraimah stated her results as follows: "software, like other instructional materials, is directed towards a male audience, with little sensitivity for the multicultural aspects of American classrooms." (1989, p. 5)

By comparing bias found in textbooks to educational software, the author was able to identify disparities in educational software which are currently in use. Ann DeVaney (1993) went deeper into the issue by examining an individual piece of software currently regarded as one of the best educational programs on the market.

In her article entitled "Reading Educational Computer Programs", DeVaney examined the content of computer software by viewing the program as a text that has been constructed in, and should be examined through, a social context (1993). By utilizing reception theory, she analyzed messages contained in the text. DeVaney felt that this text is the product of a larger discourse, one which belongs to the software author(s). Since the software entices students into this larger discourse, it is important to examine it's contents.

DeVaney analyzes the popular software "Where in the World is Carmen San Diego?" and the social discourse of which it is a part. Her findings indicate that this text is not neutral. On the contrary, she found indications of a program which reflects sexist, white, American values. She theorized this to the existence of two readers of the program: the computer and the user. Because the user is forced to read the program designed to be read by the computer, the user becomes constructed as a machine. The solution to this problem, as proposed by the author, lies in the finding of an alternative to this type of construction within the limitations of the hardware.

While this demonstrates the need to effectively and critically evaluate software that is to be used in the classroom, there is a lack of methodology in this regard among classroom practitioners. This is not to claim that software is not being evaluated, but may not be evaluated in all necessary dimensions. The bias contained in software is now more subtle then in the beginnings of software development, yet it can have the same detrimental effects. Therefore, there is a demand for more effective evaluation of software in regards to gender differences.

This issue was raised by Rosenthal and Demetrulias (1988) in their study of pre-service and practicing teachers and the effect of different evaluation forms on their identification of software as containing bias or stereotypes. The authors proposed that the more attention the evaluation form paid to gender bias, the evaluator would respond likewise and also pay more attention to bias. The results of this study were consistent with their expectations regarding the different instruments and the subtlety of the bias.

On evaluation forms which contained few, or even as little as one, questions regarding stereotypes, the evaluators were less likely to judge the software as containing bias. When the subjects employed the Expanded Sexism Checklist (ESC), developed by the authors, they evaluated the same software, previously evaluated as stereotype-free, as containing bias. This study has brought to the forefront a need for better software evaluation by those who plan to implement it.

The issue of software evaluation was examined again by Benoit and others (1991). They conducted a survey of career-oriented and educational software to evaluate the extent of gender bias. They found, by identifying stereotyped representations of women, that the software they examined contained gender bias. They also found that older software was more likely to contain gender bias then software published more recently.

As a means of overcoming this obstacle, the authors recommend that software authors implement the "publisher-established non-sexist writing standards for textbook authors." (Benoit et al., 1991) This approach, although original, is subject to some difficulty. It does not take into account the authoring systems and programming that amateur software developers utilize. Hence, there would be a gap in the software used in the classrooms, dependent upon the developer's standard.

Form

Although biased software can be viewed as the primary concern in educational computing, there are other issues. Regardless of the content of the software, students may be exposed to stereotyping in the most elementary form of the computer. This includes the students' approaches to computing and programming languages and the overall computing atmosphere, which is generally associated with mathematics and science departments.

Sherry Turkle (1984) examined the way that boys and girls approach computer programming. The views of males, who tend to see programming as a logical activity, have dominated what is taught in introductory computer courses. This approach is generally accepted as "good" programming. Turkle has found however, that the sexes approach programming very differently and identified these differing approaches as part of the difficulty young girls encounter when learning programming. The boys tended to program by a highly valued top-down approach, which requires breaking the task down into smaller tasks and the prior planning of each of these individual tasks. The girls, on the other hand, tended to approach programming with what the author calls a "soft mastery" approach, which involves negotiating with the computer at the design level. Because most young girls are discouraged from using this approach, they come to reject programming. But, as Turkle (1984) stated:

> "Thus, some girls who reject programming are not rejecting the computers as such or programming as such. They are rejecting an intellectual style that has become indissociable from it in the public mind and the minds of teachers." (p. 49)

The author goes on to draw parallels between computer science and other sciences where hard mastery is the preferred and the "hard masters" define the field. She challenges that if given the opportunity to explore the computer in their own unique way, girls may open the door to the study of other formal systems, such as mathematics and science.

The conclusions that can be drawn from this research is that girls prefer not to use computers when they are generally associated with mathematics and science. Allowing girls to learn computing in their own style will give them the necessary success to move forward in other areas. In this regard, Sherry Turkle viewed computers as the gateway for women into mathematics and science. Conversely, Suzanne Damarin (1989) viewed mathematics as the gateway into computers. She resolves that given the opportunity to practice the necessary mathematical skills, girls can be successful in computing.

Suzanne Damarin (1989) sees the affect computers have on women both in school and in the workplace as a result of their inexperience with computers, which is largely due to the mathematics which is involved in their use. The large numbers of women that leave mathematical, scientific, and computer studies, coupled with the fact that mathematics and formal logic are central to the computer's functioning, brings Damarin to urge that young girls be given the opportunity to learn about and practice these skills.

Damarin then identifies two factors which must be taken into account: affective equity and evaluation equity. The former requires that instruction be mindful to the "attitudes, feelings, and preferences" of students. The latter encourages a move away from placing value upon a narrow set of answers toward "the diversity of ways in which computers, math, and science can be understood, used, and employed" (Damarin, 1989). In the computer classroom, this means placing value on the good qualities of a program, instead of placing value on "good" programming.

One of the suggestions for the overcoming of this obstacle is to introduce girls into the world of computing as a whole. This is based on the hypothesis that if girls are comfortable in the culture of computing, they will be more successful. Corlann Gee Bush (1983) suggested that analyzing the very personal context of technology use, including the use and discussion of computing in the user's terms, would allow for a rethinking of the user context, and would result in an "understanding of the effects of technological change on women's lives." (p.160).

The context of computer usage has become more personal over time as the trend in many schools today is the introduction of the computer into many content areas, and even as a stand-alone subject. This provides many opportunities for students to find and become comfortable with computing. As a result, there is a shift away from the direct association of computers with mathematics and science, yet the gender differences persist.

In 1985, Kiesler and Sproul further examined this conflict. The authors found that while there was increasing availability of computers in society, there was not equal usage by all. The authors attributed this disparity to the perception of computing as a culture. It is because of the existence of this culture that computer training should include lessons on living within this culture, as well as skills and knowledge. As it existed at the time of the writing, computing was male dominated and typically transmitted through males both in and out of schools. The authors stated that as long as girls are unfamiliar with this culture, they will remain unfamiliar with the hardware. Furthermore, since they do not believe that there is anything intrinsic that would make computers more difficult for girls, they see a need for software which allows all children to have computer ability.

Usage

Third, there is a cause for concern in usage, both qualitatively and quantitatively. While some students may have difficulty getting close to a computer physically, others may find it difficult getting close intellectually. This barrier can be created by a variety of situations, among them are the way in which computers are introduced and how they are used in the learning environment.

Patricia Campbell (1984) examined usage/access concerns and she found that while approximately half of all students are female, two-thirds of the students learning computers are male. These figures generally hold true in and outside the classroom. Campbell suggested that the way that computers are introduced is a contributing factor to these differences.

First, computers were often viewed as "math machines" and therefore any math anxiety students may have had was transferred to the computer. Also, teachers typically used boys to help introduce the computer to the class. This was due to the perception that boys have prior experience with computers, or are viewed as more mechanical. Lastly, where there are limited computers for a large group of students, the more aggressive students, typically the males, used the computers.

As a result of the combination of these factors, young girls were using computers less than their male counterparts. As more people, especially teachers, became aware of these differences, girls gained physical accessibility to the hardware and software. The focus then became an examination of deeper issues.

Jan Hawkins (1987) examined the reports from various research endeavors regarding gender and computers. She found that both the organization of the learning and the role the computer played in the learning environment influenced computer use by males and females. Due to the link between computers and mathematics and science, the computers were often integrated into one of these areas. The result was that girls encounter difficulty utilizing the computers because of the view of these areas as male domains.

Other research Hawkins examined, studied the role of nature, nurture, and society at large in influencing girls use of computers. The general conclusions were that the characteristics of a task heavily influence the amount girls used the computers. Again, girls were less likely to use computers when programming was being taught, but were more likely to use them when word processing was the central task. In regards to mathematics and science software, girls preferred those that allowed students to work cooperatively and the goals of which were not blatantly scientific.

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These articles were written early in the computer-education relationship and the authors urged the readers to be aware of the formation of stereotypes because it was early enough to curb them. As access and usage increased there was a shift away from concerns regarding only the amount of time which was spent on computers. One study which was under way at the time found that even as students used computers more and had increased exposure to them, the differences in attitudes between the sexes did not significantly change. (Krendl et al., 1989) On the contrary, confidence and interest in computers by girls were unaffected by time. It became an issue of benefit equity, people began to examine why gender differences persisted even as the amount of time using computers leveled out.

Lockheed (1985) examined why women and girls were not using computers and attempted to explain why. She resolved that the disparity was due to the differences in the ways in which boys and girls use computers. And the manner in which they are using them has led to the defining of computing as a male domain.

As was stated in much of the research on the issue of usage, boys are more likely then females to use the computer for game-playing and programming. (Lockheed, 1985) Conversely, when the computer was used for other applications, there were little or no differences in use by gender. Unfortunately, much of what is viewed as valuable computer use is programming, resulting in the de-emphasizing of girls use of computers.

In the article "The Computer Gender Gap: Children's Attitudes, Performance, and Socialization" the authors examine gender differences in terms of access and performance outcomes. (Nelson & Watson, 1990-91) While there has historically been gender differences in education, the question remains of whether the new technologies, i.e. computers, will diminish or perpetuate existing gaps. Since the introduction of computing into all areas of school, the authors believe the transference of math anxiety to the computer has decreased. What are now viewed as the differentiating factors are the influence of the family, gender bias in the software, and the influence of the teacher.

Conclusions

From the research examined, three key inferences may be drawn in regards to interaction with computers, research methods, and research questions. The writings, dating from 1983 - 1993, examined in this analysis contain a recurring call for varying types of educational computing experiences. These would allow for differing ability and interest levels, as well as varying types of interactions. (DeVaney, 1993; Ellsworth, 1988; Rosenthal et al., 1988; Campbell, 1984; Nelson et al., 1990-1)

Also threaded throughout these readings is a common research methodology. Most of the examinations of software content and computer usage were studied through the standard research methods such as: controlled studies (Rosenthal et al., 1988; Huff et al., 1987), surveys (Demetrulias, 1985; Krendl et al., 1989; Lockheed, 1985), and observations (Kiesler et al., 1985).

Also evident in these readings are research questions which vary in their approach. As the discrepancy between gender and computing came to the surface, the initial issue was how the hardware was being used in the classrooms (Demetrulias, 1985; Hawkins, 1987; McInerney et al., 1986). This approach addressed issues of accessibility to computers and equal usage time by both sexes. As this concern was identified and then resolved, it became apparent that there were other concerns to be addressed.

Researchers (Biraimah, 1989; Rosenthal et al., 1988; Benoit et al., 1991) began focusing on the software which was being currently utilized in classrooms. Their findings, discussed earlier, established a concern for the content of this software. Many software packages were found to have varying degrees of stereotyping and bias within them.

Finally, others studied the context in which the hardware and software were being used (Krendl, 1989; Ellsworth, 1988). These studies found that the environment in which the computer was used, regardless of equal access and representation in software, effected the performance of students in regards to their gender.

The culmination of these various writings has come to the current emphasis for an examination of educational computing from a social/societal perspective rather than a technological one (Huff et al. , 1987; Kiesler et al., 1985). As has been the history of the gender-educational computing field to be reactive to such concerns, addressing this relationship through new methods may help to identify and resolve, or perhaps prevent further areas of conflict. The continuing growth of the field allows for such a change in perspective in further studies.

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Title:

Man and Machines: Three Criticisms

Author:

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As machines have become a more common part of daily life through the passage of time, the idea that the line separating man and machine is slowly fading has become more popular as well. I would like to discuss three critics of this change through their most famous works.

Mary Shelley's impact on this school of thought is obvious to this day. Although her most famous work, Frankenstein, has been interpreted in numerous ways, analyzed as statement about everything from sexual tension to a woman's role in society, one of the most popular views on the book is as a criticism of science's impact on people. The plot of the book revolves around a man of science and how his dreams of bettering man through technology go terribly wrong. This in itself could be interpreted as a statement about uncontrolled progress, but when the characters in the book are looked into more deeply a deeper criticism becomes evident. She describes Dr. Frankenstein as a man devoid of spiritual foundation, lacking in any belief in the world outside the tangible. Dr. Frankenstein describes his beliefs during his narrative in chapter 4, "...my father had taken the greatest precautions that my mind should be impressed with no supernatural horrors . . . " and later saying,"Darkness had no effect upon my fancy; and a church yard was to me merely the receptacle of bodies deprived of life...." The void left by his lack of spiritualism is filled with the drive for scientific inquiry, and thus it is the science that has become such a big part of his psyche that eventually leads him into peril.

In Frankenstein Shelley laid the groundwork for the concerns of many in the future, and created one of the most common themes in science fiction today. As Terrence Holt wrote in "Frankenstein as Science Fiction" describing the most bitter irony of the novel "The inventor's hope of accelerating evolution and the ironic devolution of both creature and creator not only reflect the central strain of nineteenth century biological theory, but also introduce two enduring themes of modern science fiction, evolution and its discontents." What she did is create a work that many people clung to at that time, for the middle class that was currently undergoing industrialization was looking for a work like Shelley's to show them that their fears were justified, "In short, Frankenstein sings the litany of a middle class undergoing industrialization,...". Shelley accomplished a remarkable feat with this work, making it accessible for the masses during her time period while being truly ahead of her time. The idea that man and science, or man and machines combination would be the next step in evolution, that pervades the book, is still a very intriguing concept, and she laid an excellent groundwork for thought to this day.

Another work that came much later, but in many ways bears a strong resemblance in message, if not theme to "Frankenstein" is Marshall McLuhan's *The Media is the Massage*. Although Shelley was likely more concerned with technology and industrialization as a whole, and McLuhan is more concerned with media, both make a strong statement about technology's encroachment around and into man's body and psyche.

In this book McLuhan states: "the wheel is an extension of the foot...the book is an extension of the eye...electric circuitry an extension of the central nervous system", he attempts to roll all of the things that are common in a persons life into that person's being, to him there seems to be little use for distinctions between man's physical makeup and man's complete make up at all. This is an interesting and relatively radical idea, but it was his predictions made from this that really drew attention to the work. McLuhan explains "Media, by altering the environment, evoke in us unique ratios of sense perceptions. The extension of any one sense alters the way we think and act- the way we perceive the world." An example would be crediting the invention of type for the growth of linear thinking, which in turn would mean if writing had evolved another way (like hieroglyphics for example) a different thought process most likely would have developed.

It is from here that he makes the prediction about man's future that drew the most negative reaction. When he wrote: "At the high speeds of electric communication a purely visual means of apprehending the world are no longer possible; they are just too slow to be relevant or effective", in other words, technology must improve or replace vision in order for man to continue growth. Many interpreted this as meaning that books and literature as known today and as they have been known in the past are no longer necessary and will fade into obsolescence. This statement acquired him scores of critics from all areas of English and communications. These individuals felt as though McLuhan was attempting to replace the soul of communication with technology in much the same way that science replaced the soul of Dr. Frankenstein in Shelley's work.

Samuel Florman's *The Existential Pleasures of Engineering* is related to these first two works, as he is concerned with the relationship between man and machine. He differs from my first two subjects significantly, as they spoke in speculation, Florman speaks about what has happened. It is easy to see how engineers as whole, being closest to technology would be the most effected by it, and thus *The Existential Pleasures of Engineering* finds its niche. Throughout the book Florman makes no real distinction between Engineers and their work, and even make efforts to blur the line between the two.

Instead of speaking about what could happen if man and machine become too close, he speaks about what has happened due to this combination. A nostalgic tone pervades the beginning of the book, speaking about the glory days when the creations of the engineer brought him acclimation and pride, in contrast to the blame and mistrust of today. It is interesting to see how he admonishes those who criticize the engineers, at one point trying absolve the engineer of responsibility from the results of their work, yet later on trying to strengthen the connection. An example is his refute of criticism from antitechnologists, where Florman disregards their attitude because they speak of technology "as if it had and existence of its own."

I regard The Existential Pleasures of Engineering as a book for the new man shaped and built with machines, a book that begins with the premise that the engineer and his work are one, and then goes from there. Deliberately or not, it gives a remarkable account of how the things predicted in the past have come true. An excellent example is the relationship between technology and the morals of the engineer. Florman says: "I submit that study of the liberal arts will rob him of his innocence, stain his character, make him less 'moral'- or at least less naive." If this is true, it is an incredible indication of how the morals of the engineer are formed, apparently from the things that they build, instead of from the society they build for.

As the first generation raised with computers from birth reaches maturity I think that the precedents set in the past will prove very influential in the future. Whether or not man will lead machine or machine will lead man has yet to be decided. It will be very interesting to see to what extent the predictions and ideas given by these three authors develop in the future.

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Title:

Creating a Learning Environment For Teachers

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Abstract

This paper presents the theoretical framework for a new course for teacher education. It describes how computers have been used in education and identifies factors that contribute to the unrealized potential of technology use in schools. This new course is consistent with a constructivist view of learning, new educational goals, and a view of the role of technology as a tool that can support the attainment of educational goals and increased student learning.

Throughout the twentieth century, each time a new form of media or technology appears on the market, predictions have been made concerning the vast changes that it will undoubtedly bring to classrooms and to the educational process. The arrival of personal computers was no exception. Researchers and futurists predicted great changes to come due to the presence of computers in our schools. The envisioned changes were not realized, however, through the mere existence of machines in classrooms or school buildings. In fact, change has been so slow that in many schools computers have yet to move from administrative offices to classrooms.

Computers are having an enormous and pervasive impact on our business world and on society. The scope of their effect has focused more attention on classroom teachers' use of technology and the perceived failure of education to fully utilize computers in the instructional process.

A Brief History of Computer Use in Education

Many reasons are cited for why the adoption and use of computers in schools and classrooms has not matched predictions. Primary among these are expense of hardware, as well as lack of adequate software and teacher training. These are definitely real deterrents, but in some schools that have the hardware, software, and training, computers are still sitting in closets or in the back of classrooms, unused.

Teaching the technology is the obvious change that accompanies the introduction of any new technology. With the introduction of computers, some schools that identified the importance of computer skills chose to focus on teaching computers as a separate curriculum while others carefully planned and integrated computer literacy objectives into the curriculum. Still others chose to implement some combination of these approaches (OTA, 1988).

When personal computers first appeared in classrooms, their instructional use took one of two roles. The first use was to teach about the technology itself, including computer literacy and programming language courses. The second use was to support the current curriculum through the use of educational software such as tutorials and drill and practice. In most cases computers were used to support traditional goals, using established methods with as little change as possible to the classroom setting or well-established routines (Olson, 1981, 1980). In such settings, the computer did little to change the curriculum or to truly impact education.

With the growing expectation for the instructional use of computers in classrooms and the identified need for teacher training, colleges and universities began to offer computer literacy courses for teachers. The evolution of these courses has paralleled that of computer literacy courses in schools. Computer literacy courses have evolved from courses that taught about computers (their history and component parts) and introductory computer programming, to courses that have replaced programming languages with basic software applications (word-processing, spreadsheets and databases). These courses have attempted to address how these skills can be used to support *instruction* and how the use of computers can be integrated within the curriculum. They have, however, supported teachers' views of computers as additional content that needs to be taught within an already crowded curriculum.

Factors Contributing to the Use of Technology in the Classroom

The implementation of technology as an instructional tool is a form of educational change and needs to be viewed and treated consistently with what we have learned concerning change. The use of technology is tied to the reform of education (AIT, 1994) in additional ways as well. It can support the attainment of the educational goals that have been identified for success in the information age society of the twenty-first century. One lesson that we must not forget is that reform efforts must deal with the **system** as a whole.

Teacher development has focused on training in the use of technology. Learning to use technology is not sufficient for teachers to make this change in their teaching styles. Even more important than "how-to" training is educating, teaching "why" (Jost and Schneberger; 1994). Teachers, like all learners, need to see the relevance for using the technology. Teachers need to understand how technology can support instruction and learning, how technology can help us to do things (accomplish important educational goals) that either would be very difficult or impossible to do without the technology. This requires a change in seeing the role of computers (or technology) as instructional and learning tools, not as add-ons or content. Demonstrating and discussing the potential of various technologies, introducing new uses of technology, and supporting teachers in exploring different technologies and software can support teachers in constructing a different understanding of their own discipline. Teachers can benefit through activities that support their reflection of what they teach and why.

In order to have teachers use technology in constructive ways that support educational change and educational goals, we must first assess their views on learning and instruction. The use of technology as instructional and/or learning tools is compatible with a constructivist view of learning and instruction (Jost, 1992). In research concerning teachers' integrating technology into instruction, it was also found that teachers' views concerning instruction, learning, and teacher-student roles were not only reflected in the goals that teachers hold for their students but also affords the teaching styles they use and the role that technology can assume in their classrooms (Jost, 1992). Teachers need the opportunity to reflect on *how* and *what* they were taught compared to what is important for today's students to learn. They need to see the consistencies between new goals for education, new theories of learning and instruction, and innovative learning activities and methods of assessment.

Teachers must also construct an understanding of the changing roles of technology, teachers, and students. Learning environments require a change in the roles of both teachers and students. The teacher's role in student-centered learning environments is to guide, stimulate, facilitate and support students' learning activities. Teachers also facilitate student-to-student interaction, modeling desirable thinking and learning behaviors. Using technology as learning tools in the classroom also requires teachers to see their class, including themselves, as a community of learners (AIT, 1994).

Support is a real problem that exists in the culture of educational organizations. The existence of the basic tools is not enough. Teachers are not given the time or the freedom to explore the instructional uses of technology or to redesign curriculum or lesson plans. Teachers need time to experiment and become comfortable with new instructional techniques and with technology.

Why Do We Want Teachers to Use Technology?

Many educators, researchers, and businessmen have emphasized the need to rethink our goals for education. Concurrent with the redefinition of educational goals is the emergence of new assumptions about learning and instruction. Schools are responding by creating information-rich environments for instruction and administration utilizing technology as the vehicle for restructuring education to meet the needs and challenges of our information society.

The use of technology can support the kinds of active environments that research on learning suggest are supportive for enabling students to construct meaningful knowledge. The role of technology within learning environments is that of a learning tool - providing access to information, facilitating inquiry and communication, supporting collaboration and knowledge construction. In addition it can function as a productivity tool to support other instructional and administrative activities.

These rich environments promote active knowledge construction in authentic and meaningful contexts. They also encourage students to assume a more responsible role in their own learning (Grabinger & Dunlap, 1994); support the development of collaborative decision-making and problem-solving; and foster the development of research and meta-cognitive skills. Social interaction is an important component in these environments, supporting cognitive development (Vygotsky, 1987; Wertsch, 1985). This approach stresses the process of learning, including the important component of reflection, rather than the learning of content alone. This philosophy is consistent with preparing a student for the future.

Based on the assumption that we believe it is important to teach higher-order learning, thinking and inquiry skills that utilize technology as learning tools, we must prepare today's teachers to be capable of implementing an instructional model which affords students the generative learning opportunities which support the attainment of these educational goals (e.g., Cognition & Technology Group at Vanderbuilt [CTGV], 1992). The research of both the CTGV (1992) and Jost (1992) indicate that for teachers to implement an instructional model which effectively uses technology as an instructional tool they must have student-centered, constructive views on learning, and view their role as facilitator rather than as disseminator. Teacher education, therefore, must include teaching and modeling of a generative instructional model, the integration of technology as a tool, and a constructive view of the learning process.

Teaching a philosophy or theory alone is not enough. Teachers must be shown, through modeling, examples of instructional strategies and learning activities that put these ideas into action. Changing one's teaching style is not an easy task. People revert to what's comfortable, which is teacher control, a teacher-directed (content-centered) style. It is easier and is what we have had the most experience with. For many teachers, being able to effectively make the change will first require a conceptual change concerning their beliefs about learning and instruction. A generative learning environment promotes a climate of collaborative inquiry in which questioning and reflection are integral components. Questioning and reflection are also important for promoting conceptual change; therefore, participating in this type of learning environment should support conceptual change.

Teaching with Technology is a new course for teacher education which links the use of technology with appropriate learning theory and pedagogy. It focuses on how students learn and how technology can be used as part of a learning environment that promotes and enhances that learning. This course is also part of a research project that can be characterized as simultaneously working toward change and observing and reflecting on that process. It is a form of Action Research where we are not only studying beliefs, practices, and behaviors (in the form of teacher constructs) but are also attempting to change them in certain ways.

The main objective of this project is to create a learning environment for teachers and teacher educators which will graduate professionals capable of teaching in collaborative learning environments which utilize technology as instructional and learning tools. The theoretical framework underlying this environment includes assumptions about educational goals and the nature of learning. This framework is consistent with the goals expressed by Resnick & Klopfer (1989), the National Council of Teachers of Mathematics (1989), and the American Association for the Advancement of Science (1989).

This R & D project includes the design and development of learning activities and tools which model instructional strategies and provide inquiry into emerging educational goals, methods of assessment, learning activities, and the role of technology in the learning environment. It also includes activities to promote students' reflection on their beliefs concerning learning, instruction, and the role of technology within education.

Significance

The design of innovative educational environments has both theoretical and practical outcomes. The three main aspects to this type of research include: theory-building, research on learning, and design (engineering).

This study can inform instructional designers concerning the design of learning environments and the development of instructional models for teaching-with-technology. It can also inform teacher educators concerning effective methods and desired outcomes for teacher education programs.

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Title:

Teacher Decision Making Regarding Content Structure: A Study of Novice and Experienced Teachers

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Abstract

This study examined how content considerations influenced the instructional strategy decisions reported by novice and experienced teachers. A total of 152 preservice and 153 in-service teachers completed an instrument which asked the teachers to indicate the likelihood they would include selected instructional functions in lessons dealing with well-structured and ill-structured content. The results indicated that both novice and experienced teachers would vary their instructional strategies based on content structure. Surprisingly, their reported variations were similar and consistent with the literature regarding instruction for well-structured and ill-structured content. The results raise questions about the tacit knowledge preservice teachers have about instruction. The results also have implications for teacher evaluation.

Teacher Decision Making Regarding Content Structure: A Study of Novice and Experienced Teachers

Teachers are often characterized as decision makers. For example, they decide which topics to teach, how the topics should be sequenced, and which examples to use. These decisions influence instruction and ultimately impact learning outcomes; they are based on information about learners, subject matter, and other pertinent factors (Shavelson & Stern, 1981). Shulman & Grossman (1988) extended the notion of teacher as decision maker by providing a theoretical model of the domains of teachers' professional knowledge, including subject matter knowledge and pedagogical content knowledge (i.e., understanding how to represent specific subject matter topics and issues). Teachers draw from these domains as they plan and implement instruction.

One particularly important decision related to subject matter knowledge and pedagogical content knowledge centers on the extent to which the to-be-learned content is "structured." Rosenshine and Stevens (1986) placed content on a continuum ranging from well-structured to ill-structured. Examples of well-structured content include English grammar and mathematics facts; ill-structured content includes writing poetry and analyzing social issues. Rosenshine and Stevens indicated that instructional strategies should be adjusted based on the extent to which the content is well- (or ill-) structured.

The purpose of this study was to examine how content considerations influence the instructional strategy decisions reported by novice and experienced teachers. Specifically, the study investigated how teachers' instructional strategy decisions reflect the distinction between well- and ill-structured content, and how teaching experience is related to these decisions. It was hypothesized that experienced teachers would be more likely than novice teachers to make appropriate instructional strategy decisions for a given content structure.

Literature Review

The literature on teacher decision making is broad and well developed, especially at the intersection of content structure and instructional planning. The review which follows first examines the role of teacher knowledge in instructional planning. Then the review provides a more detailed look at the literature related to content structure and instructional planning. Finally, attention is given to the issue of how novice and expert teachers approach instructional planning.

Teacher Knowledge and Instructional Planning

As mentioned earlier, teacher decisions are based on the knowledge the teacher uses in the process of planning, conducting, and evaluating instruction.

Thompson (1992) reviewed the literature and noted that studies of the relationship between teachers' beliefs about teaching and instructional practice have yielded inconsistent results. In some cases, (e.g., Shirk, 1973; Grant, 1984) a high degree of agreement was found between teachers' professed views of mathematics teaching and their instructional practice. In other studies (e.g., Brown, 1985; Cooney, 1985), discrepancies between beliefs and practices were found. Thompson concluded that "...any serious attempt to characterize a teacher's conception of the discipline he or she teaches should not be limited to an analysis of the teacher's professed views. It should also include an examination of the instructional setting, the practices characteristic of that teacher, and the relationship between the teacher's professed views and actual practice." (p. 134)

In proposing a model for research on teacher knowledge, Fennema and Franke (1992) argued that teacher knowledge cannot be separated from subject matter, from how that subject matter can be represented for learners, from what we know about students' thinking in specific domains, or from teacher beliefs. Fennema and Franke pointed out that "...within a given context, teachers' knowledge of content interacts with knowledge of pedagogy and students' cognitions and combines with beliefs to create a unique set of knowledge that drives classroom behavior." (p. 162)

In discussing teacher knowledge, Berliner (1986) argued that successful teachers develop expertise in pedagogy and content knowledge, and understand how these two forms of knowledge interact in teaching. In the context of the current study, this suggests that successful teachers will adapt instructional strategies to match relevant content factors (e.g., degree to which the content is well-structured).

Instruction for Well-Structured Content

Rosenshine (1986a, 1986b) argued that there is ample research to describe a pattern of instruction (referred to as explicit teaching, direct instruction, systematic teaching and/or active teaching) that is useful for teaching any well-structured discipline where the objective is to teach performance skills or mastery of a body of knowledge. This pattern was thought to be most important for young learners, slow learners, and "...for all learners when the material is new, difficult, or hierarchical" (Rosenshine, 1986a, p. 62) and less relevant "... in areas which are 'ill structured,' that is, where the skills to be taught do not follow explicit steps." (Rosenshine, 1986b, p. 6)

In an extensive review of the literature, Rosenshine and Stevens (1986) examined several major studies, for example, the Texas First Grade Reading Group Study (Anderson, Evertson, & Brophy, 1979, 1982) and the Missouri Mathematics Effectiveness Study (Good & Grouws, 1979). Based on these and other studies, Rosenshine and Stevens identified six instructional functions that effective teachers employ. Effective teachers conduct daily reviews and check previous work, present content in an organized manner, guide student practice, provide feedback and correctives, provide opportunities for independent practice, and conduct regular reviews. However, Rosenshine and Stevens cautioned that these instructional functions were most appropriate when teaching well-structured content.

Content Structure Issues

Content structure is based on notions of how and if to-be-learned-content is organized. For example, Posner and Strike (1976) identified five general approaches for organizing course content: world-related sequence, inquiry-related sequence, learning-related sequence, concept-related sequence, and utilization-related sequence. Posner and Strike indicated that these five sequences were "well grounded in what have proven to be useful distinctions in epistemology." (p. 667)

In another attempt to describe content organization, Reigeluth and associates (Reigeluth, Merrill, & Wilson, 1979; Reigeluth, Merrill, Wilson, & Spiller, 1978) identified three content structures - conceptual, theoretical, and procedural. Reigeluth (1987) argued that "...in all the work that has been done on sequencing, elaborations based on concepts, principles, and procedures are the only three we have found, although additional ones may be identified in the future." (p. 249) The underlying assumption in these and other organizing approaches is that to-be-learned content is sufficiently well-structured to allow for organization to occur. However, some would argue the point that all content is well-structured.

In a critical review of Reigeluth's work, Wilson and Cole (1992) take issue with the notion that content can (and should) be characterized within the confines of any one knowledge structure. Citing numerous sources, Wilson and Cole concluded "...there is no single right way to represent knowledge, even for a given context or instructional purpose." (p. 68) They go on to argue that "...a single representation of structure could possibly limit students' personal constructions of meaning from the content." (p. 69) While Wilson and Cole are focusing on Reigeluth's work, they are simultaneously raising questions about the utility of an instructional approach which presupposes the existence of well-structured content.

Assuming that some to-be-learned content is well-structured and other is ill-structured and that this distinction has implications for selecting instructional strategies, the discussion now turns to a brief review of the teacher decision making literature in the context of expert and novice teachers.

Expert/Novice Teacher Decisions

Considerable research has been conducted examining the differences between expert and novice teachers in terms of their decision making. Westerman (1991) conducted a study comparing the thinking of expert and novice teachers during three stages of decision making: planning, teaching, and reflecting. Westerman concluded that novice teachers tend to develop lesson plans in which content knowledge and theoretical knowledge of teaching are minor influences.

Westerman's conclusion was consistent with Borko and Livingston (1989) who examined the planning, teaching, and reflections of student teachers and their cooperating teachers and found differences between the two groups. Specifically Borko and Livingston found that expert teachers displayed more pedagogical knowledge, content knowledge, and pedagogical content knowledge than did novices. Similarly, Brown and Borko (1992) reviewed the literature on expert and novice teachers and concluded that expert teachers typically display more pedagogical content knowledge than do novices.

Literature Summary

In summary, the literature generally supports the notion that content can be thought of along a continuum ranging from well-structured to ill-structured and that instructional decisions should, in part, be based on the extent to which the content is well-structured. Furthermore, the literature suggests that experienced teachers will be more likely to make instructional planning decisions based on this consideration than will novice teachers.

The research described below examines experienced and novice teachers' instructional planning decisions in the context of well- and ill-structured content.

Method

Subjects

As detailed in Tables 1 and 2 below, a total of 152 preservice (i.e., novice) and 153 in-service (i.e., experienced) teachers participated in the study.

Table 1. - Novice teacher demographics

Variable	N	%
Major		
Early Childhood	21	13.8%
Elementary	71	46.7%
Secondary	54	35.6%
Other	6	3.9%
Total	152	100%

Table 2. - Experienced teacher demographics.

	Years Teaching Experience						
	0-5	6-10	11-15	16-20	21-25	26+	Total
Early Childhood	7	2	0	0	0	0	9
Elementary	23	13	10	7	3	0	56
Junior High	14	7	3	7	4	0	35
Secondary	13	10	4	6	3	1	37
Post Secondary	6	1	2	2	3	1	15
Other	1	0	0	0	0	0	1
Total	64	33	19	22	13	2	153

Instrument

Based on Rosenshine and Steven's (1986) work, a survey was constructed to assess the likelihood that novice and experienced teachers would include selected instructional functions in lessons dealing with well-structured and ill-structured content. The survey included a brief introduction with explanations and examples of well-structured and ill-structured content. The survey consisted of nineteen instructional strategies. Participants responded to each strategy in terms of how likely it was for that strategy to be included in a lesson on well-structured content and then in a lesson on ill-structured content. A five point Likert-type scale was used with a response of "4" indicating "Always" and a response of "0" indicating "Never." The nineteen items were organized into one of the six instructional functions identified by Rosenshine and Stevens (see Table 3). Demographic data were also collected on the survey.

Table 3. - Instructional function clusters and related items (Rosenshine & Stevens, 1986).

Instructional Function/Items

- I. Daily review and checking previous work
    1. Check homework
    2. Review relevant past learning
    3. Review prerequisite skills
- II. Present new content/skills
    4. Provide statement of objectives
    5. Proceed in small steps but at a rapid pace
    6. Provide illustrations and examples
- III. Guided student practice
    7. Initial student practice takes place with teacher guidance
    8. Initial practice is sufficient so that students can work independently
    9. Prompts are provided during guided practice
    10. Guided practice is continued until a success rate of 80% is achieved
- IV. Feedback and correctives
    11. Quick correct responses are followed by another question
    12. Slow correct responses are followed by helpful feedback (Right because...)
    13. Students are monitored for systematic errors
- V. Independent student practice
    14. Independent practice to over-learning (responses are firm and quick)
    15. Independent practice until 95% correct rate is achieved
    16. Students help accountable for seatwork
- VI. Weekly and monthly reviews
    17. Systematic review of previously learned material
    18. Frequent tests
    19. Reteaching of material missed in tests

Procedure

Data collection was accomplished in two ways. Novice teachers completed the survey while enrolled in an undergraduate teacher education course. Experienced teachers were surveyed by graduate students as a part of a research methods course activity. No attempt was made to randomize or stratify either the novice or experienced teacher groups participating in the study.

Participants were told that the survey was part of a lesson planning study and that their responses would be anonymous. Most participants completed the survey in less than ten minutes. Data from the completed surveys were entered into a SPSS-X database and analyzed.

Means and standard deviations were computed for each cluster by groups (novice/experienced) and by content structure (ill/well). T-tests were calculated on the mean differences between scores for well- and ill-structured content, and between scores for novice and experienced teachers. The results of this analysis are summarized and discussed below.

Results

As shown in Table 5, novice teachers' means for lessons on well-structured and ill-structured content ranged from a low of 2.40 (Independent Practice for ill-structured content) to a high of 3.33 (Daily Review & Check Homework for well-structured content). For experienced teachers, the means ranged from a low of 1.99 (Weekly & Monthly Review for ill-structured content) to a high of 3.20 (Daily Review & Check Homework for well-structured content). Interestingly, novice teachers' scores were always higher than experienced teachers' scores regardless of instructional function or content structure. Data analysis (t-test) indicated significant differences ($p<.001$) in the likelihood that a specific instructional function would be used for teaching well- verses ill-structured content. This difference was found for novice and experienced teachers.

Table 5. - Reported likelihood of using instructional functions with well- and ill-structured content. (4 = Always, 0 = Never)

	Novice Teachers					Experienced Teachers				
	Well-Structured		Ill-Structured			Well-Structured		Ill-Structured		
	M	(SD)	M	(SD)	Mean Difference	M	(SD)	M	(SD)	Mean Difference
Daily Review & Check Homework	3.33	(.54)	2.59	(.85)	.74*	3.20	(.57)	2.54	(.72)	.66*
Presentation	3.23	(.50)	2.66	(.75)	.57*	3.12	(.53)	2.60	(.77)	.52*
Guided Practice	3.00	(.54)	2.62	(.73)	.38*	2.95	(.57)	2.41	(.79)	.54*
Correctives & Feedback	3.09	(.55)	2.47	(.86)	.62*	2.82	(.56)	2.28	(.77)	.54*
Independent Practice (Seatwork)	2.83	(.63)	2.40	(.80)	.43*	2.54	(.68)	1.97	(.74)	.57*
Weekly & Monthly Reviews	3.19	(.55)	2.41	(.83)	.78*	2.73	(.75)	1.99	(.90)	.74*

*$p<.001$

Somewhat surprisingly, there was no significant difference between novice and experienced teachers in terms of their reported likelihood of using different instructional strategies based on content structure (see Table 6). Ranging from .04 to .16, none of the mean differences between experienced and novice teachers approached statistical significance. Put another way, both novice and experienced teachers indicated they would vary their instructional strategies based on content structure considerations, and their reported variations were similar.

Table 6. - Means, standard deviations and mean differences of reported likelihood to use various instructional strategies when teaching different types of content. (4 = Always, 0 = Never)

	Novice Teachers		Experienced Teachers		Mean Difference Between Novice & Experienced
	Difference Between Well-Structured & Ill-Structured		Difference Between Well-Structured & Ill-Structured		
	M	(SD)	M	(SD)	
Daily Review & Check Homework	.74	(.88)	.66	(.75)	.08
Presentation	.57	(.87)	.52	(.75)	.05
Guided Practice	.38	(.85)	.54	(.74)	.16
Correctives & Feedback	.62	(.96)	.54	(.80)	.08
Independent Practice (Seatwork)	.43	(.90)	.57	(.79)	.14
Weekly & Monthly Reviews	.78	(1.02)	.74	(.89)	.04

*p<.05

Discussion

In this study, both novice and experienced teachers indicated they would vary instructional strategies based on content structure. Furthermore, the variations reported by novice teachers were similar to those reported by experienced teachers. These results have implications for teacher preparation in the context of teacher knowledge and practice. The results also have implications for teacher evaluation. The discussion which follows examines these issues.

Teacher Knowledge and Practice

As discussed earlier in the literature review, Berliner (1986) argued that successful teachers develop expertise in pedagogy, content knowledge, and their interaction as they amass a large quantity of knowledge through teaching experience. Furthermore, Westerman (1991), Borko and Livingston (1989), and Brown and Borko (1992) pointed out that experienced teachers tend to display greater pedagogical content knowledge which is superior to that of novice teachers. Surprisingly, in the current study, novice teachers displayed a knowledge of the interaction of pedagogy and content structure in the absence of extensive teaching experience. One might wonder then, how was this knowledge obtained?

In a study of over 400 preservice teachers Serow, Eaker, & Forrest (1994) found that preservice teachers' orientations to teaching "seemed largely independent of their exposure to teacher-education curricula"....and "were typically grounded in personal experience rather than pedagogical theory or research." (p. 46) Serow, et al, indicated that preservice teachers' personal experience has been derived, in part, from years of observing their own teachers' pedagogical practices suggesting that "...few other fields provide potential recruits with such close-up, sustained exposure to their work." (p.43) In the current study, the novice teachers were likely making instructional strategy decisions based on years of observing their own teachers, rather than on knowledge and skills developed through their teacher preparation program (as borne out by the fact that no decision-making differences could be attributed to years in the teacher preparation program).

Teacher Evaluation

While somewhat tangential, the basis for this study (specifically Rosenshine & Stevens, 1986) and the study findings have implications for teacher evaluation. Many teacher evaluation instruments currently in use are based on one model of effective instruction and do not reflect the need for variations in instructional functions based on content structure. For example, the Texas Teacher Appraisal System (TTAS) was designed with "efforts to build a practical, usable system that can be applied fairly to teachers in all subjects and grade levels" (p. 6, TTAS Appraiser/Teacher Manual, Texas Education Agency, Austin, TX). However, Lasater and Hawkins (1993-4) reported three studies which focused on art teachers' and art teacher evaluators' perceptions of the appropriateness of the TTAS for use in the art classroom. The majority of teachers questioned the validity of the TTAS for evaluating art teachers. Lasater and Hawkins found similar views among special education teachers who reported a need for content-sensitive evaluation instruments. The argument here is that instruments lacking this sensitivity not only are incomplete, they have the potential of discounting "correct" decision making practices. According to the current study, both experienced and novice teachers are likely to vary their instructional strategies based on content considerations (i.e., well/ill-structured). Consequently, a teacher who is teaching ill-structured content and using appropriate strategies may receive a less favorable evaluation than would a teacher who is using inappropriate strategies if the evaluation instrument does not reflect the distinction based on content structure.

Recommendations and Conclusion

The findings of this study are inconsistent with much of the literature on teacher decision making, especially as it related to novice and experienced teachers. Several additional studies will help resolve the inconsistencies. First, the current study did not include asking the subjects how they made their decisions. For example, if a subject indicated that a review of prerequisite skills was more likely to be included in a lesson on well-structured content that in one on ill-structured content, the rationale underlying the decision is unknown. Was the decision based on knowledge of content and pedagogy, or was it based on other considerations (e.g., the time required to review prerequisite skills)? It is conceivable that a novice teacher's rationale is considerably different from that of an experienced teacher, a distinction consistent with the novice/expert literature.

Second, in the current study, the subjects were given several examples of well- and ill-structured content and asked to indicate how likely it was for selected strategies to be included in an unspecified lesson on each type of content. Consequently, it is unknown if similar decisions would be made if the list of strategies was not provided, a condition more akin to teachers' daily practices. Future studies might provide two sets of outcomes, one based on well-structured content and one based on ill-structured content, but not provide a list of strategies. Here, novice and experienced subjects would be asked to describe how they would teach for each set of outcomes, the intent being to minimize the prompting provided by the list of strategies. Their responses could then be analyzed using the Rosenshine and Stevens (1986) framework as a guide.

Finally, direct observation of instruction by novice and experienced teachers may help close the gap between the current study and the literature. Such a study might begin with a survey of the subjects (either closed-ended as in the current study or open-ended as suggested above). Following the survey, the study would extend into the classroom where teacher decisions are enacted. Lessons on well- and ill-structured content could be observed and the teachers interviewed following the lessons. The interview could focus on key events during the lessons and the teachers' decision making associated with the events. These data could then be analyzed using the Rosenshine and Stevens (1986) framework as a guide.

In conclusion, while the research outlined above will address the gap between the current study and the literature, one over-arching question cannot be ignored. Are novice teachers able to make more sophisticated decisions than they are given credit for in teacher education programs? If that is the case, then perhaps teacher education programs can concentrate more on helping novice teachers implement these decisions and less on building the knowledge base underlying these decisions.

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Title:

A Collaborative Multimedia Development Project for Rural Training: Results of a Beta Test and Adjustments to Design

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Vast numbers of adults in our changing society need specialized training to perform well on the job. Yet, that training often eludes people who live in rural areas, for they often have difficulty finding opportunities to receive further professional development. In an attempt to improve services to rural populations, distance education has become an increasingly popular form of continued training to adult audiences. The growing emphasis on distance education recognizes the needs of rural professionals who may not have the time or resources to travel to more central training sites.

Like some other professions, the increasing workplace demands on social workers require a feasible solution to providing on-the-job training for those who reside in both urban and rural areas. Social workers face a difficult situation; they need to know more information to keep up with changing policies and provide quality services, while at the same time increased responsibilities make it more difficult to leave the office for training or education. While distance learning opportunities have multiplied greatly in the past several years, the lack of relevant course work and access to the technology necessary to participate in these opportunities may prohibit the wide use of distance education for rural social workers.

There is a critical need to provide carefully designed training to meet the challenges rural social workers face, yet limited resources for staff development within the social work agencies create a difficult situation in meeting this training need. The consultation and assessment process for planning staff training becomes vital in this situation because any training offered must wisely utilize the limited resources by concentrating them on the most essential needs. Schoenmaker (1993) addresses this phenomenon and reveals a trend toward better communication between trainees and training developers in order to validate design decisions prior to developing the training materials. The training team in this study is practicing such communication.

Following a needs assessment, multimediated training for social work professionals was planned. The first of ten modules was designed, developed, and beta tested prior to field placement.

This paper reports results of a beta test specifically aimed at checking the perceived quality of a multimedia lesson prior to its release to a field test situation. It represents one step within the process of maintaining communication between the trainees and the training developers. In this case, the trainees are social workers who live in rural areas and the developers are a team of people with various professional skills.

BACKGROUND

Collaboration between two major institutions in a rural midwestern state identified specific training needs for child welfare workers and a five-year plan to meet them. The State Department of Social and Rehabilitation Services (SRS) contracted with the a major state university to develop a series of ten multimedia lessons (modules) for child welfare workers that would emphasize the educational needs of workers in the rural parts of the state.

The first step of the learning process assessed the workers' perceptions of their needs. The second step developed a plan to meet those needs. The third step involved design and development of educational modules using multimedia (videodisc, computer, workbook) for the delivery. This paper reports on the beta test phase of the first module of the project, which was intended to help guide the project toward improvement prior to releasing the module as a finished product. The beta test investigated user opinions about the content, instructional design, technical integrity, ease of use, and general quality of the module. Because people's opinions about self-efficacy, ease of use, and quality can influence their attitudes toward the instruction and in turn, influence performance and implementation patterns (Fullan, 1982; Klein, Knupfer, & Crooks, 1993; Rogers, 1983; Soltani, 1995), it is important that designers consider learners' opinions about the quality of material in terms of its usability and perceived value.

This program was designed so learners could set the pace of the lesson, and work through it at a rate commensurate with their available time, ability, and motivation. The learners have the option to start and stop at any time, and to repeat portions when necessary or desired.

The underlying rationale for self-pacing is that individuals learn at different rates. One claim made in favor of using technology for instructional is the ability of technology to adapt instruction to individual differences thereby gaining efficiency while at the same time promoting achievement Semb et al (1993).

Research clearly demonstrates that a variety of self-paced formats such as computer-based instruction (Bangert-Drowns, Kulik, & Kulik, 1985; Kulik & Kulik, 1987, 1989; Kulik & Bangert-Drowns, 1985; Orlansky & String, 1981), Bloom's Learning for Mastery (Kulik, Kulik & Bangert-Drowns, 1989), and Keller's Personalized Systems of Instruction (Kulik, Jaska, & Kulik, 1978) engender more positive attitudes about learning than conventional instruction. In addition, they are more effective, efficient, and preferred by the learners. (Soltani, 1995)

Formative Evaluation

It is helpful to think of formative evaluation as an explicit stance throughout the design process in which one collects data and uses them to inform the design procedures. While the project is still fluid, the beta test serves as part of the formative evaluation. The results of the beta test will be applied to design adjustments in this first module and the remaining nine modules.

Several researchers have developed a basic set of categories by which instructional software can be evaluated. For example, Morrison, (1987) placed maximum emphasis on the facet of interactivity which he defined as 'the learner in conversation with himself over the material to be learned'. He addressed the idea of adaptability where the program gives control back to the learner. Morrison claimed that well-designed products offer users an opportunity to find individual pathways through material and encourage learners to develop higher cognitive skills of self-assessment and evaluation of their own learning style and patterns.

Plowman(1989) explored such facets of learning design in as it specifically applies to interactive video. Important categories for evaluation which emerged include considerations of navigation and mobility through the software, physical aspects of human-computer interaction, screen presentation, quality of learner interactions, consistency of appearance and functionality, visual clarity, legibility, access to support in the form of 'help' and 'next' options, availability of a bookmark facility, user support tools like a glossary or other reference items, the style of user interface which might embody windows or other devices to maximize the amount of easily available information. The design of this project considered all of those factors, plus some additional ones.

Instructional Courseware Design

A courseware production system has been defined as the entire set of activities beginning with vague ideas or concepts to be taught and ending with finished materials for the users (Karrer, 1987). A production strategy means the combination of resources to set up and run a production process of courseware development; it must address the questions of manpower, required skills, and tools for development (Karrer, 1987).

Many authors have called for a team approach to courseware development. Ally (1985) suggested a five-member courseware design team which included a manager, instructional designer, computer specialist, communication specialist, and content specialist. Collis and Gore (1987) called for a collaborative model which included in its design a rigorous system which enabled team members to check and re-check work done by themselves and others by assessing congruency at several points in the development process. Faiola (1989) described the traditional team with one more person, the graphic or visual specialist. Because assessment is such an important part of the process Collis and Gore suggest placing in the collaborative model a step for field testing prototypes.

Because of the specific nature of the profession, social workers can have a tremendous impact upon human lives at particularly vulnerable times. Therefore, it is important that they receive ongoing education that will enhance their practical, applied skill concerning human services. Reay (1986) argues in favor of changing the focus of social work training from content issues to process issues. This could be done by limiting the theoretical information and choices, and rigorously encouraging students to master conditioned response (CR) learning and progress to understanding the learning process and applying the theory. Using this approach of embedding theory in practice, presents on an opportunity for the combination of modern technology and adult methods of learning to help students master the process of systematically applying theory to practice.

General psychological research and theory yield fundamental, widely generalized principles concerning how individuals think and learn. General psychological principles are largely media-independent. Psychological constructs such as schemata (Norman, Gentner, & Stevens, 1976; Spiro & Anderson, 1981);

meaning (Bandura, 1971); elaboration (Wagner & Rohwer, 1981); and situated cognition (Brown & Duguid, 1993; Suchman, 1991) emphasize how individuals organize and retrieve knowledge and establish meaning, and hence have far rèaching implications for the design of learning systems that will allow the application of theory to practice.

Motivational Adult Instruction

Designing instruction for adult learners must take in those special considerations that are a major factor in adult learning. Adults have specific and unique motivational needs. The motivational aspect of the design can increase the learners efforts and attract learners to the instructional content and methods. (Keller, 1983) .

The motivational instruction can increase the amount of time and effort the learner will put into the task. Keller (1987), Keller and Suzuki (1988) as well as Keller and Kopp (1987) identify four categories of motivating strategies in learning situations, which include: attention, relevance (Keller's ARCS Model), confidence, and satisfaction. All of these strategies were incorporated into the design of this program. The needs of the learner were assessed and a design team addressed each aspect as follows:.

Attention. Content related anecdotes, case studies, and biographies are appropriate along with animation and sound. (Keller, 1987) The specific content developed by the subject matter experts contains all the current topics and issues pertinent to the social workers. The appropriate designs by the graphic artist take into consideration what is appropriate for the user/client

Relevance. Showing how the instructional materials relate to specific and current needs. How the instruction and information relates to ones job, and to real life.

Confidence. Giving the learner the locus of control. Throughout the program, the user has options, the ability to make choices and the freedom of navigation.

Satisfaction. Using skills learned in simulated situations Keller & Kopp (1987). The interactive video component takes the learner into environments which in effect lets you think while seeing and doing.

Adult professionals typically need to improve work performance. The computer-based interactive videodisc training program, has the potential to assist in learning and thus is very motivational.

Continuing Education

Computer-based simulations, especially those incorporating interactive video capabilities, have been demonstrated as effective instructional methods in medical, industrial, military and business context (Reeves, 1988). One positive aspect concerning this formative evaluation is that the module was previously approved for three continuing education credits.

Individualized Learning Process

According to Gotz, (1990), the learner can designate the time and place of learning. Advanced programs offer different paths of instruction in the processing of instructional material. The amount of material can be selected according to the skills and qualifications of the learner. The learner can call up help programs and systematically prepare for tests through simulations and visual instruction. A knowledge control of or classification of tests results can be integrated into the program and the learning sequences can be repeated as often as needed.

Distance Education

Distance Education, although long established, is currently in a stage of rapid evolution. The most fundamental motivation for distance education, that of reaching learners who are geographically hindered from meeting in a traditional setting, has been expanded to include motivations such as time tailoring and flexibility of learner characteristics. At the same time, advances in the technological media are adding new dimensions to distance education. In particular, the contribution of 'electronic distance education' strategies with respect to the problems of inequities in opportunity for isolated learners or learners with special needs is becoming increasingly recognized (Stubbs & Burnham, 1990).

Social and Rehabilitative Services was especially supportive of the project because of the large number of social workers from rural areas that would be trained.. They need to receive comparable services and have equity of access. The computer-based interactive videodisc program is meeting that need.

Mecklenburger (1990) stated that an advantage of multimedia and the capabilities it adds to distance learning is that learners can learn wherever they are. One of the advantages of this is anytime, anywhere learning.

Effects of Multimedia

The popularity of electronic learning, especially interactive multimedia, centers around the potentials of the media. Kelly (1990) cited four such potential:

1. The new media provides rich opportunities to learn. The combination of sight, sound, and interactivity provides opportunities to learn new things without ever leaving the classroom.

2. The media also provides the unexpected benefit of increasing opportunities for teaching people to work in teams and honing other interpersonal skills.

3. The technologies can make it easier to meet the varying needs of individual learners by being able to : diagnose what the learner knows; identify any learning difficulties the learner might have; and then attend to those needs. Also, the technologies enable the learners to go at their own pace.

4. The new technologies can provide new tools to assessment of skills.

Research provides ample evidence for the power of visuals and interactive multimedia to enhance learning (Carlson & Falk 1990-91; Dwyer 1982, 1978; Knupfer & Clark, 1992). This multimedia module had the potential to offer visually rich instruction.

RESEARCH QUESTIONS

Several research questions were of interest. The research questions of particular interest in this formative evaluation were:

1. Do learners like the module?
2. Do learners believe that the lesson is realistic, valuable, and relevant?
3. Do learners believe that the multimedia format works well for delivery of this lesson?

4. Do learners believe the video sequences are valuable?
5. Can learners navigate easily within the lesson?
6. Are learners likely to use the extra features, such as the glossary or content map?

7. Does the module function properly, including the bookmark feature?
8. What strengths, weaknesses, and suggestions do the learners have?

9 How much time does it take to complete the module?
10. Are there differences in the way social workers and instructional designers rate the module?

METHODOLOGY

Subjects

Subjects for this study included twenty people; 11 were social work graduate students or professionals, and 9 were graduate students of educational technology. The social work subjects were selected because they would be typical of the group of learners for whom the instruction was designed. They likely would represent about the same technical skill level and would have background knowledge necessary to judge the merit of the content and presentation style of the training. The educational technology students were typical of instructional designers who would be responsible for developing similar multimediated lessons.

Materials

Subjects in this study used the multimediated lesson titled "Child Development" which is the first module of the Building Family Foundations series. In addition, they completed a 43-item questionnaire.

The multimediated lesson was based on an IBM 486 computer system with a Pioneer videodisc player. It used Toolbook as the authoring system.

A set of written materials composed a workbook that accompanied the electronic part of the lesson. The workbook was designed as a reference that social workers could keep close-at-hand and xerox as needed for doing their job independently or working with clients. The workbook contained instructions for starting the lesson, and any text-based information that a social worker might like quick access to, especially when working with a client. For example, the workbook contained a glossary of terms, informational articles, references that a social work might like to refer to, and forms that could be duplicated and used on the job or distributed to clients.

The survey instrument used to collect the data contained 29 items based upon a four-point Likert-type scale, 10 open-ended questions, and 4 rank-order questions asking what mode of delivery subjects would prefer for future lessons.

Procedure

Each subject was given a brief introduction to the equipment and asked to complete a learning module independently and in its entirety. The instructions included a request for each subject to try to use the bookmark feature one time; other than that, no specific requests were made concerning the process of module completion.

Immediately after completing the module, each subject filled out a questionnaire about the experience. The completed questionnaire was collected before the subject left the site. Summary statistics were gathered and changes recommended based upon the beta test.

Data Analysis

The data were analyzed using summary statistics, chi square analysis, and qualitative analysis. The structured questions combined with the open-ended questions provided an opportunity to gather the kinds of information that we anticipated was important as well as the spontaneous reactions of the subjects.

RESULTS AND DISCUSSION

The subjects who used the multimediated lesson represented two occupations and thus, two points of view; those knowledgeable in the social work content and those knowledgeable about interactive courseware design. The social work subjects (SW) were likely to provide information about such things as content accuracy, flow, relevancy, and presentation style, while the instructional design (ID) subjects were likely to react to such things as human interface design principles, graphic design and use, navigation, and other features related to instructional design.

One potential area of difficulty was experience with this type of mediated instruction. Of the 11 SW subjects, 4 had used a multimediated lesson before while 7 had not, and of the 9 ID subjects, 8 had used a multimediated lesson before while 1 had seen multimedia but had not actually experienced using it. Ages ranged from 21 through 47 years, with an average SW age of 27, an average ID age of 37, and an average of 31 years overall.

Realism, Valuable, and Format

The overall reaction of both groups was that this kind of program is valuable for learning this type of content and it is especially useful in the case of a distant audience, such as rural social workers. The SW subjects were relatively new users of technology and their reactions displayed overall enthusiasm of having a well-organized instructional program that offered them audio, video, dynamic graphics, and text. Approximately 90 percent of the SW subjects and 100 percent of the ID subjects agreed or strongly agreed that the content was accurate, while 100 percent SW and 100 percent ID subjects agreed or strongly agreed that the content was realistic.

Concerning relevancy, 82 percent of the SW subjects and 78 percent of the ID subjects believed that the content was relevant to their needs, while 90 percent of the SW and 89 percent of the ID subjects believed that the multimedia format presented a convenient way to learn the material. Even though the ID subjects were not studying social work, their notation of relevancy would reflect the generic nature of interest in child development. The module was designed to help social workers recognize children who should be referred to a specialist for evaluation and potential help. Certainly any parent or person who works with children in any way would have some interest in the topic.

Thirty-six percent of the SW group and 72 percent ID group believed the content needed more depth, while 91 percent SW and 100 percent ID agreed or strongly agreed that the module content was clear. Virtually all of the subjects believed that the lesson contained valuable information and that it was valuable learning experience for them to use this form of instruction.

All of the SW subjects and 90 percent of the ID subjects believed that this style of lesson was a good way to learn the content, while 72 percent SW and 87 percent ID were satisfied with their own performance.

Video

One area of potential strength for this lesson was the video component. Approximately 80 percent SW and 66 percent ID agreed or strongly agreed that the video information helped them to understand to concepts. None of the SW subjects believed that the video was not relevant, but 22 percent of the ID agreed that the video was not relevant to the lesson content. The ID subjects seemed to look more intensely at the actual design and expressed some concerns including a more critical evaluation of the video portions of the program.

The length of the video segments in relationship to the information given and the relevancy of specific visuals were critical points. Subjects expressed a desire to stop the video and replay only small sections rather than longer pieces. This suggests a need to make sure there is a good video match, but even further that shorter segments of video be used so that learners can repeat targeted sections.

Navigation, Functionality

Navigating through the software was a potentially problematic area for SW subjects who had little experience with this type of mediated instruction. Ninety percent of the SW subjects and 100 percent of the ID subjects agreed or strongly agreed that the module content was easy while no one thought it was difficult or hard to use. Despite that fact that no one thought is was difficult, 9 percent of the SW subjects and 22 percent of the ID subjects agreed or strongly agreed that the content was confusing.

Even though the design team advocates users choice, there are some controls on navigation to assist with directing the learners to prerequisite information or the desire of the subject matter expert (SME) to be sure that the learners cover a certain area within a segment. The ID subjects saw this as restrictive, but made the comment that this may be a good design feature for new users to help prevent them from getting lost within the program. The beta test revealed need to make sure all check marks stayed in place for the duration of a learner's use of a module. The check marks indicate topics and subtopics that have been completed. Learners wanted to be able to back track one screen at a time to recheck information rather than going back to the beginning of a section.

The bookmark feature was designed as an easy way to restart the lesson after taking a break.. It kept information such as check marks to record progress and the specific place where a user left off during the last usage. Learners' individual records were stored on their own floppy disk upon exiting form the program. Among the information tracked is length of time spent on the module; that is important to enable learners to get continuing education credit.

Although hot words with definitions in pop-up boxes, an on-line glossary, and content map to check where they were and where they could hop to were included, but they were very virtually unused. All subjects tended to go straight through the program in a linear sequence. The bookmark feature was something that might be used in a real work setting, but here each person only used it as part of the test.

The suggestions gathered led to changes in content, screen design, and general flow of the program. It will be important to give some sort of orientation to the next group so that they know how specific features can help them. To help clarify the lesson and alleviate confusion, revisions to the content introductions, transitions, areas of emphasis, and content map were made.

Time

The average length of time in minutes to complete the module for SW subjects was 138 (low 50, high 230, SD 48.95) and for ID subjects was 142 (low 90, high 180, SD 30.32). Approximately 80 percent SW and 55 percent ID believed that the lesson was about the right length, while 9 percent SW and 11 percent ID believed that it was boring.

Strengths

The overall reaction about the strengths of the lesson referred to the power of the video to help visualize concepts and the good organization and logical flow of content categories. The aural, visual, and textual interaction with the learner was viewed as an appropriate way to accommodate the different learning styles.

The SW subjects were particularly pleased with the opportunity to see actual vignettes of situations that related directly to the content. both SW and ID subjects believed the navigation was friendly enough to help alleviate some potential confusion about certain areas of the content.

Weaknesses

The main weaknesses of the lesson concerned the relationship of review and test questions to content presented, the relevancy and length of video segments, and the inability to go back a few screens without taking a large jump backwards.

Although the instructional designer had worked with the SME to write appropriate objectives and good questions matched to the objectives, the content presentation fell short on emphasizing the important points. In fact some questions contradicted the content and therefore were confusing. Revisions to the lesson presentation were necessary to provide enough clear and consistent information related to the test questions.

Colors and Graphics

Reactions to colors and graphics are most likely related to the learner's experience. The SW subjects like the way that the graphics were presented and the colors that were used, while the ID subjects wanted the graphics to be more lively and found the colors dull. The two groups had opposite views here, reflecting their experience and expectations.

CONCLUSIONS

In general, the subjects responded favorably to the multimedia training and believed that the video component added value to the experience through the use of examples and demonstrations. A few SW subjects expressed the preference for traditional classroom instruction where they could ask questions. The more experienced social workers made suggestions to improve the content, while the less experienced students and instructional designers focused their comments more on the technology and program flow.

Although the design team had built some fancy features into the module, the subjects did not use most of them. That could have been due to their limited experience with multimedia and technology in general, a way of presenting the features that is less than obvious, or lack of time to explore.

The design adjustments recommended from the beta test can be categorized into three areas: content, instructional design, and technical integrity. With the subject matter expert being a member of the design team, the content and clarity was one of the positive features. In addition to attending to the features noted earlier, we recommend chunking the information better and adding even more variety of perspectives to cover a diverse population of learners. We further recommend the inclusion of a person within the design team who could be classified as an expert who can authenticate certain ideas from within a cultural perspective. In this case, the social workers were very helpful as part of the beta test team. Experts on child development and special education were also included.

The instructional design features mentioned earlier were corrected and the actual design interface was revised to improve navigation. Changes were made in fonts, colors, layout of the screen. One drawback of the SMEs being the project directors has been pressure to present information in a way that the designers felt matched linear video, but not necessarily multimedia. Those issues were revealed and addressed with each member of the design team contributing a strength.

The decision was made to revise the program that records the learner's path throughout the program. The bookmark feature was modified and improved to allow more flexibility. It is also important to pinpoint a the specific features of hardware that the learners will have in their various remote sites because a few of the keyboard variations can make difference in program functionality. The programmer made changes to avoid sensitive features that can be anticipated, but this limits our ability to be specific with learner instructions.

We recommend that the module be field tested in a variety of sites prior to full distribution. Within the field test we recommend that the data collected include measures of attitude, confidence, expectancy, comfort level with technology, knowledge, achievement, and satisfaction with the multimedia lesson.

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Title:

BUILDING COMMUNITY: DEMOCRACY, DISCOURSE, AND PRAXIS

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A Working Paper for the Research and Theory Division Symposium 12th Open Forum on Foundational Issues

BUILDING COMMUNITY:
DEMOCRACY, DISCOURSE, AND PRAXIS

There are two positions I want to take regarding this symposium:

1. As a society we lack a conceptual framework to engage in moral discourse, and we lack clear understanding of the notion of democracy; and,
2. To build "real" community (as opposed to "virtual" community) requires a means to engage each other in moral discourse; a clear understanding of the notion of democracy; and a radical and critical praxis.

I have ten minutes in which to establish these positions. Consequently, these remarks will be broad, not detailed. These remarks are meant to engage us in conversation. I am not playing "devil's advocate" here, rather I am looking for conversation that will push us into areas that we can explore toward building community. My interest is in building community where we are. This is particularly true for me as an educator within an institutional setting that at times seems to be at odds with building a democratic, participatory community.

These two positions are inter-related so I will develop them together. My discussion should include the following points: establishing the need for a moral discourse; presenting initial ideas for an understanding of democracy; and offering some insight into the notion of radical and critical praxis that will provide the possibility for building community.

Traditionally, schools have been involved/concerned with the notion of democratic ideals and practices. Thomas Jefferson had specific proposals for schools in Virginia; Horace Mann proposed specific reform through common schools; more recently, "A Nation at Risk" (1983) proposed reform measures because the schools were failing in their mission of fostering strong "products" to maintain the economy and the "American-Way of Life".

Historically, the notion of democracy has changed over the years. How we talk about democracy has changed. School responses to these changing notions of democracy have created different programs of reform, e.g., desegregation of schools, Head Start, regaining "lost economic and military ground". (see Beyer, 1988). The shifting notions of democracy result in multiple responses that are sometimes contradictory. There is no one vision of democracy; visions of democracy have "competing interests" as well as differing notions of "social justice"; and because of our inability to engage in moral dialogue within society (especially within schools), it is increasingly difficult to clarify, debate or act on these visions, much less develop historical understanding. This inability of society (and the "schools") to provide a forum for the open discussion of these visions of democratic ideals results from

> ...a loss of communities within which such discourse can become meaningful and prompt the requisite social action. Surrounded by larger institutional structures favoring technization, commodification, and the therapeutic privatization of social relations, we have all but lost a sense of the collective social good so necessary for discussion of democratic ideas (Beyer, 1988, p.221).

Beyer (1988) argues that we have "lost the ability to use moral language sensibly". Quoting Alasdair MacIntyre:

> what we possess ... are the fragments of a conceptual scheme, parts which now lack those contexts from which their significance derived. We possess indeed simualcra of morality, we continue to use many of the key expressions. But we have- very largely, if not entirely- lost our comprehension, both theoretical and practical, of morality (Beyer, 1988, p.223).

Beyer (1988) attributes the inability to use moral language sensibly to forms of academic theorizing that have "weakened the authenticity and potency of moral discourse" (p.223). He discusses three such forms: First, conceptual analysis in philosophy which tends to separate moral debate from social context. (1)

Secondly, a position of "epistemological and ontological" dualism with a commitment to certitude through forms of empirical investigation. The dualism "inherent in positivistic endeavors demeans the viability of moral judgments" (p.225).(2) And, third, the university research community, as a community of scholars involved in the "conservation, development, and dissemination" of our cultural heritage, shifted their allegiance, becoming more closely allied with "social and governmental agencies, and responsive to the demands of the growing corporate sector". This had the effect of further separating moral discourse from "the production of knowledge", which production happened within increasingly narrow disciplines and sub-disciplines, while moral inquiry belonged to one area of academic inquiry (p.225).

Purpel (1993) sees the need for a moral discourse within society generally, but within education specifically. He identifies a dangerous chasm between "mainstream educational discourse and the urgent social, political, and moral crises of our time" (p.278). Public debate both within and without education seems to center on technical (as opposed to critical) issues. He suggests that this technical, instrumental educational discourse focused on technical issues should be of concern to all those who believe education offers possibilities for hope toward overcoming the many current problems of society. Schools have a role to play, but not the role.

This form of educational discourse focuses on "ameliorating" the existing system, seeing it as something to be fixed or "fine-tuned" but not something to be transformed. Yet the urgent social, political, and moral crises of our time demand more than fixing/fine-tuning. These crises demand engaging in a moral discourse. Moral discourse for Purpel means not only "moral analysis", but also the task "must include forging a moral vision- one that can inform and energize our political will and educational strategy" (Purpel, 1993, p.282). This "moral vision" includes confronting "painful and anguishing dimensions of current educational practice" (p.282). (3) The moral vision must include "the problematics and limitations of the various reforms and critiques that range from criticisms of teachers working conditions and ways to basic curriculum reform" (p.282).

Purpel (1993) acknowledges the fragmentation and isolation that indicates a crisis in community, but rejects the notion of a "common knowledge" that binds people together. Rather we need to "forge a greater share of community through a common moral vision" (p.283).

At this point I need to present a notion of democracy and community that reflects my position.

TOWARD A NOTION OF DEMOCRATIC PARTICIPATION

I will identify features of democracy that will outline my position:

1. Democracy must be linked to a set of values regarding such issues as social justice, the common good, equality, freedom, community. These terms embody those broad problematic areas that sometimes go by the name of the "American Creed", or the "American Ideology". Hence, to act democratically means to be guided by, to be informed by, that set of values.

These issues are problematic. To inquire into these issues requires a commitment to moral discourse.

2. These values must be more than abstract principles, more than intellectual pursuits, but again, they inform our work. Thus, there needs to be some involvement with the "political" notion of "civic education".

This notion of democracy cannot be a-historical. As Giroux (1988) states, "Democracy is a 'site' of struggle and as social practice is informed by competing ideological conceptions of power, politics, and community" (pp.28-29). To develop a language of citizenship and democracy requires examination of the "horizontal ties between citizen and citizen". Here we are concerned with the notion of difference wherein the demands, cultures, and social relations of different groups must be recognized as part of understanding what it means to be a pluralistic society (cf Giroux, 1988, p.30). Thus "difference and identity" must be central to any debate regarding democracy and politics. This means that "theories of difference" are not only concerned with representation of identities (how the "Other" is represented), but also must be concerned with issues regarding relations of power (Giroux, 1994, p.58).

Identity here must be seen as "...the effect of social struggles between different communities over issues of representation, the distribution of material resources, and the practice of social justice" (Giroux, 1994, p.61). This understanding of identity exemplifies what is meant by democracy as a site of struggle.

What this means for education is that it is not enough to read the texts of the "Other". Wanting to know the Other, according to Hazel Carby "... cannot replace the desire to challenge existing frameworks of segregation". She pointedly asks: "Have we, as a society, successfully eliminated the need for achieving integration through political agitation for civil rights, and opted instead for knowing each other through cultural texts?" (quoted in Giroux, 1994, p.59).

This again points to the political notion of citizenship. For educators this means developing that set of values mentioned above that will inform our work.

The challenge for educators is how "to expand the basis for dialogue and community without erasing a politics of difference" (Giroux, 1994, p.59). Weeks states

> We may not be able to find, indeed we should not seek, a single way of life that would satisfy us all. That does not mean that we cannot agree on common political ends: the construction of what can best be described as a "community of communities", to achieve a maximum political unity without denying difference (quoted in Giroux, 1994, p.59).

CONCLUDING COMMENTS

I would like to conclude with a final comment on the notion of democracy being a site of struggle. Given the complexity of our society today, the global economy, our national economic outlook, legislation favoring corporate interests, minimum wage employment fueled by a service economy and the demise of the middle class in terms of living wages and loss of industry, the rich getting richer and the poor getting poorer and growing in numbers, the backlash against multiculturalism through a discourse of what Giroux (1994) calls "imaginary unities of common culture and national identity" (p.57; also cf Schlesinger, 1993), etc., these complexities exemplify what is meant by democracy being a site of struggle.

Recognizing that text-based media can become the basis for our public discourse and can help shape that discourse, we cannot confuse our creating and receiving texts through our keyboards with the struggle for democracy. Democracy is fought for face to face. Democracy is fought for over specific issues. The struggle for democracy is local, as local and specific as our workplace.

Noam Chomsky, in a recent interview (1994), was asked for tangible things for people to do to try to change the world. His response was

> I try to keep it in the back of my mind and think about it, but I'm afraid that the answer is always the same. There is only one way to deal with these things. Being alone, you can't do anything. All you can do is deplore the situation. But, if you join with other people, you can make changes. Millions of things are possible, depending on where you want to put your efforts (pp.105-106).

As Chomsky suggests here, and as I have tried to argue in this paper, it is in community, in the company of others, where our sites of struggle can make a critical difference.

ENDNOTES

1. This has to do with looking at "ideal types" which have the essential characteristics of the issue under discussion (e.g. notions of freedom, social justice, etc.). This form of conceptual analysis looks for refinement and analysis of word use/meaning in particular situations to clarify meaning. The end is to be more precise in what a term means, in order to identify and correct ambiguous or incorrect usage (cf Beyer, 1988).

2. Here Beyer is referencing the over-reliance on positivistic forms of inquiry (empirical science) which claims objectivity, value neutrality, and an atheoretical stance. Within such a position "knowledge is to be found precisely by separating our observations and analyses from that untrustworthy social context from which, as Plato surmised, only opinion can spring" (Beyer, 1988, p.225).

3. Purpel (1994) is quite specific here regarding the "painful and anguishing dimensions of current educational practice", and is worth quoting at length:

> Teachers are caught up in a system in which individual achievement, competition, success and aggressiveness are essential and central elements. It is a system in which education becomes an instrument in legitimizing and defining hierarchy; in which schools are a site where people are sorted, graded, classified, and labeled, hence giving credence to the tacit social value that dignity is to be earned. Teachers are asked to prepare students differently-some are to be given the encouragement and skills to be leaders, whereas others are taught to endure their indignities quietly and proudly. It is a system that helps sustain and legitimize a society reveling in consumerism, jingoism, hedonism, greed, and hierarchy" (p.282).

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Title:

Developing Electronic Performance Support Systems for Professionals

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Abstract

This paper discusses a variety of development strategies and issues involved in the development of electronic performance support systems for professionals. The topics of front-end analysis, development, and evaluation are explored in the context of a case study involving the development of an EPSS to support teachers in the use of alternative assessments. Strategies and concepts such as rapid prototyping, formative experimentation, usability, and socio-technical perpectives are highlighted.

Developing Electronic Performance Support Systems for Professionals

Professionals come to their jobs in today's rapidly changing workplace from a variety of different backgrounds each with a collection of different interests, skills, and expertise. As a result, educational planners see the need to provide multiple and alternative educational experiences, rather than try to design the one best training program (Scribner & Sachs, 1991). A method for meeting this challenge is to provide people learning opportunities and experiences on-the-job and at the time of need to bridge knowledge gaps and skill deficiencies encountered while performing their jobs (Geber, 1990; Gery, 1991; Law, 1994).

A new tool integral to the success of this approach is what has been coined by Gery (1991) and others as an Electronic Performance Support System (EPSS). In its most basic form, an EPSS is a computer-based performance tool consisting of an informational database, an advisory system, models and examples, and a tutorial/learning base composed of granular-sized pieces of computer-based training all linked to one another in a relational database. The primary characteristic of this system that allows the user to solve problems due to a lack of knowledge or skills is the ability to quickly access well-structured pieces of information, advice, models, and tutorial assistance at the moment of need as determined by the user in the context of the present performance problem. These systems range in complexity and sophistication based on the development resources available and the nature of the performance support context. To date, most of these systems have been developed for use in business, industrial, and governmental and military settings, however, this appears to be changing. Instructional technologists and other educators are examing ways in which these systems can be developed to support teaching and learning in educational settings (Brush, Knapczyk & Hubbard, 1993; Collis & Verwijs, 1995; Goodrum, Dorsey & Schwen, 1993; Schwen, Goodrum & Dorsey, 1993).

The Learning and Performance Support Laboratory at the University of Georgia is currently developing an EPSS to support school teachers in the use of alternative assessments. The EPSS is being designed to assist teachers at all levels of the assessment process covering a range of subject domains and grade levels. Among the many activities involved in using alternative assessments, this EPSS is being structured to support teachers in the design, selection, implementation, evaluation, or administration of a variety of performance-based assessments coming under the rubric of alternative assessment. This paper presents critical design issues that developers may encounter in developing an EPSS for professionals. The Alternative Assessment Resource Center for Teachers (AARCT) will be presented as a case study to illuminate the issues discussed. The design issues are organized into three main categories outlining the development processes utilized: (1) Front-end Analysis; (2) Development; and (3) Evaluation and Research.

Front-end Analysis

Matching techniques with types of problems

Developers of EPSSs are currently using a combination of traditional instructional systems development (ISD) procedures, software engineering principles, human factors principles, and a great wealth of intuition based on experience about what makes sense and seems to work best (Gery, 1995; Witt & Wager, 1994). Because different types of professions require different sets of skills (e.g., computer technicians, customer service representatives, business managers, physicians, teachers), developers of EPSSs are being asked to support a range of job-related skills from procedural tasks to complex problem solving. While procedural-type tasks lend themselves nicely to traditional ISD front-end analysis procedures such as task analysis or procedural analysis, other tasks involving problem solving of ill-defined, complex problems might be better analyzed, and subsequently better supported, using other methods that examine how people in these contexts solve problems and make decisions in which there is usually no one right answer.

Ill-defined, complex problems that may require the expertise of an experienced problem-solver in a particular domain (or work environment) are difficult to adequately train people for using the traditional ISD approach. This is because for many ill-structured or ill-defined problems, heuristics rather than algorithms are required to achieve ends (Tripp & Bichelmeyer, 1990). A heuristic can be thought of as a "rule of thumb" method for solving problems. It is not considered to be a guaranteed method for solving the problem, but is usually faster and more tractable than the correct algorithm (Ashcraft, 1989). Heuristics are just one example of the repertoire of reasoning tools expert problem solvers have as a result of experience in a particular domain. Documenting and understanding the expert's reasoning processes as he or she reviews past experiences to solve similar or novel problems can be a powerful method for learning how an expert solves problem in a performance context.

Case-based Reasoning for Analyzing Complex Problems

In the absence of relevant task-specific procedures, teachers often rely on instructional principles derived from their experiences as teachers, or other teachers in the case of teachers new to the profession, to help guide them in the decision-making process. This may also involve adapting examples from support materials such as teacher handbooks, textbooks, videotapes, computer databases, or other types of curriculum resource materials. Similar to other types of professionals (e.g., physicians, attorneys, business executives, etc.) teachers become highly skilled at adapting relevant examples (i.e., instructional plans) from one situation to fit a new instructional problem that is related in some aspect. These types of problem solving and decision making strategies indicate, as some researchers (Kolodner, 1992; Riesbeck & Schank, 1989) have found, that experience plays an important role in both the development of domain-specific problem solving skills as well as the refinement of those skills when novel problems are encountered. The process of examining previous cases to solve similar problems is referred to as Case-based Reasoning (CBR).

Developers of the *Alternative Assessment Resource Center for Teachers* found that a case-based reasoning approach was the best method for analyzing the extensive and complex nature of issues involved in conducting alternative assessments. A traditional task analysis could not easily absorb the vast array of knowledge, skills, and expertise that teachers brought to bear when solving problems and making decisions that usually involved many instructional variables. For example, portfolio assessment requires the evaluation of a broad spectrum of information for making important decisions about a student's work. The teacher must take into account a variety of considerations relating to each student's achievement. A task analysis used to understand this process may uncover some key steps involved in the process, however, much of the context-specific problem solving knowledge utilized by experienced teachers may not be revealed. As Laffey (1995) notes in the development of an EPSS for technicians at Apple Computer, "the (employees) could easily see how the use of cases in (the EPSS) mirrored their own informal strategies for solving hard problems. The (employees) saw value in having access to a rich and broad set of real experiences and in the processes that keep the set of experiences current" (Laffey, 1995). Examining cases that are set in the context of the work environment that is to be supported can provide developers of EPSSs a powerful method for better understanding much of the knowledge, both explicit and implicit, that professionals utilize in performing their jobs.

Case Study Approach

It became clear to developers during the initial analysis phase of trying to identify key tasks related to conducting alternative assessments that much of the knowledge and skills that should be supported were actually evident in many of the general principles used by experienced teachers. Therefore, the decision was made to focus on identifying a range of assessment examples that represented many of the key principles guiding teachers in the various processes. Once many of these examples were identified, a process for documenting the cases using a multimedia format was determined. The use of multimedia case studies as a framework to both gather data and structure support information was decided to be the primary development strategy for collecting and organizing other support materials within the system.

Data Collection

A systematic data collection tool was developed for focusing efforts on how to best document cases when visiting the schools. Because time is always at a high premium for teachers, decisions such as what kinds of media elements to be gathered were made prior to arriving at the school by using the data collection worksheet. Developers conducted pre-interviews with teachers to get an idea of the types of elements that should be highlighted in cases, as well as to prepare teachers for videotaped interviews about their role in the assessments. This methodology for collecting a source of rich data for multimedia case studies proved to be helpful in maximizing limited time constraints.

Development Issues and Strategies

Rapid Prototyping Methodology

The developers of AARCT took the position from the beginning that developing an EPSS for teachers had to be a participatory design process involving the teachers if the product was ever going to be anything that teachers would really use. Also, to achieve a high level of usability there would also have to be a development process that afforded considerable amounts of iteration involving conceptualizing, developing, testing, and revising. This iterative design process which is common in software engineering is referred to as prototyping. When the process of constructing prototypes is accelerated, so that the time from beginning a prototype to evaluating user interaction with it is short enough to allow time for substantial changes to the product, then this process is usually termed rapid prototyping (Hix & Hartson, 1993).

A rapid prototyping methodology was chosen to afford developers the creativity and flexibility to "get it right" referring to desired usability standards. While the idea of creating the "perfect" interface may be unrealistic, the use of software engineering principles such as prototyping and usability testing are ways to increase the likelihood that users will be able to use the system successfully. This approach appears to be well supported in the EPSS literature as mostly anecdotal evidence. As Gery (1995) points out, "few (designers) are guided by a set of integrated and fully articulated design principles. Many innovations are the result of individual or team creativity and iterative design employing rapid prototyping coupled with ongoing usability and performance testing".

The first prototype proved to be a valuable lesson in usability testing. Developers constructed a working prototype using an authoring system that allowed them to test information/knowledge organization and navigational strategies (See Figure 1). A school building metaphor was used as an interface design. Also accompanying this were a panel of menu buttons that forced the user to delimit choices based on assessment type, grade level, and content/subject area. A focus group of fifteen school teachers viewed a demonstration of the system that had a few example pieces hard linked to one of the cases. After going through the initial demonstration sequence, the developers were soon made aware by a majority of the teachers that the delimiting strategy of narrowing down choices based on pre-defined categories was not only counter-intuitive but represented antithetical ways of thinking about instruction. Most of these teachers taught interdisciplinary units that combined topics from a wide variety of content domains, therefore, the navigation structure did not support the way they thought about instruction (or assessment). In addition, some of the representative teachers taught more than one grade level and did not like the "arbitrary selection" of grade levels. This could be thought of as a discrepancy between the developers' mental models of this domain and the teachers' mental models. A mental model, simply put, is the learner's naturally evolving model, or internal representation, which summarizes his or her own knowledge about a process or thing, often taking the form of an informal theory (Norman, 1983). Mental models are representations that are active while solving a particular problem and that provide the workspace for inference and mental operations (Halford, 1993). The teachers asked for an interface that reflected their mental models -- an interdisciplinary approach to content domains, grade levels, and assessment strategies. Their mental models of how the interface should look reflected how they think about their jobs and the tasks involved. This information was lacking for the developers and became evident in their interface design.

In summary, it is useful to first interview intended users to get an idea at some level about how they think about a task or performance context. Then, start with an idea and test its conceptual validity with a sample of intended users before launching into any high-level screen design. By-passing this sequence may only prove that you have a different mental model about a type of work environment and its associative tasks than someone who actually works in that particular performance context (See Carroll & Olson, 1984).

Evaluation Issues and Strategies

Formative Experimentation

A strategy that works well with the goals of rapid prototyping to include the intended users in the design process is called formative experimentation. Newman (1990) describes formative experiments as a type of research/design method that "sets a pedagogical goal and finds out what it takes in terms of materials, organization, or changes in the technology to reach the goal". In this way design, formative evaluation, and research are all tied together and directed toward reaching a goal. In this case, developers of the AARCT are examining ways in which to best support teachers from a variety of backgrounds and levels of expertise in the use of alternative assessments. It is believed to really achieve this that developers will need to work closely with teachers using prototypes of the EPSS to see how they are using it, if at all.

As others have suggested (Goodrum et al., 1993), by examining the socio-technical aspects of technology in the workplace, it becomes important to recognize that technology is only one critical, highly interactive, and interdependent component of the whole organization or setting. When considering the use of an EPSS to support performance in a work environment it is necessary to consider all of the elements and methods that make up the way in which work is conducted. Developers of EPSS need to examine the social, cultural, and organizational aspects that affect the way in which work is performed in the work environment. By using methods like formative experimentation, developer can "test" and "tweak" systems to take into account many of these factors influencing work.

The developers of the AARCT are interested in seeing not only how teachers are using the system to support them in the use of alternative assessments, but they are also interested in seeing how teachers will restructure their work as a result of having this system available. Will they make it part of their normal planning time to utilize the system? Will they use the system to help manage the tasks involved in alternative assessments? Will they share information learned about the system with other teachers? Will they find it desirable to update the system periodically to include new cases? These are just some of the questions that the developers of the AARCT will examine as the system is tested in a few of the schools participating in the project. Many other questions will be posed throughout the formative experimentation process to see how the goal of supporting teachers in these tasks can best be achieved with the EPSS.

Conclusion

Developers of EPSSs should examine a variety of development strategies in an attempt to find out what best works for their situation. The developers of the AARCT are utilizing principles found in instructional systems, software engineering, performance technology, and formative experimentation to develop an effective EPSS for teachers. There are, of course, many other strategies that could prove to be valuable as well in this and in similar endeavors. What is important to keep in mind, however, is that by making usability a goal and focusing on the social, cultural and organizational factors that influence how work is performed by professionals in a specific work context, developers increase the likelihood of developing effective EPSSs that support the people and the organization in meeting their goals.

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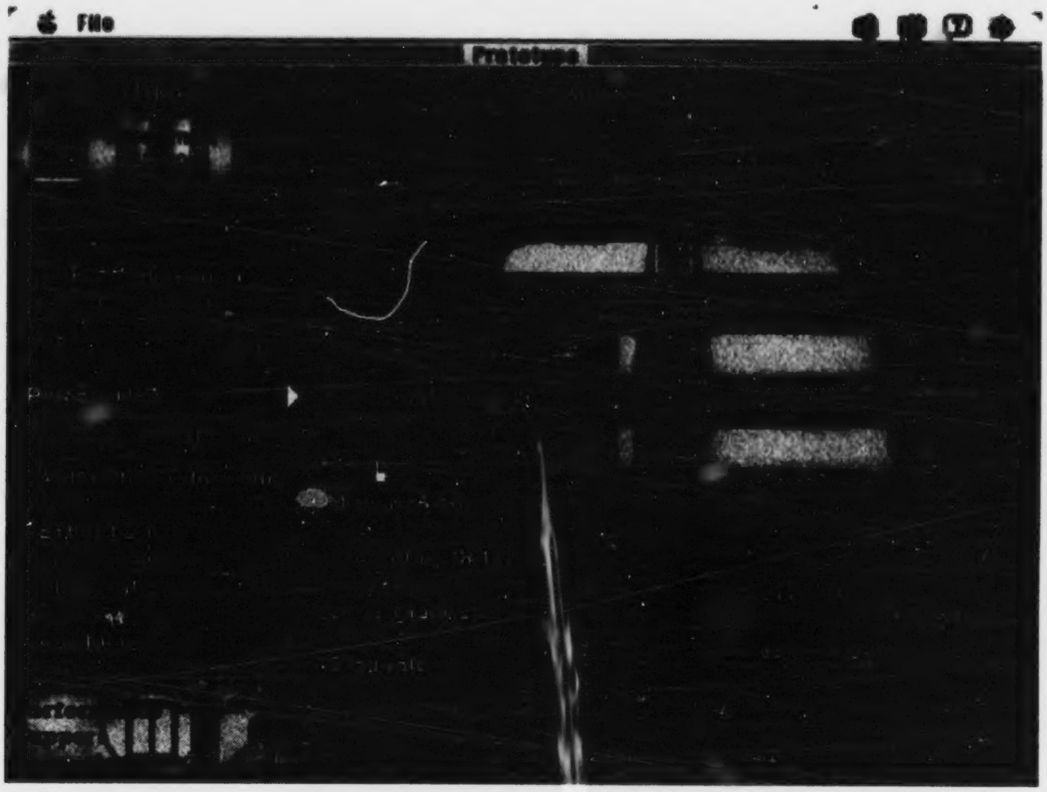
Figure Caption

Figure 1. Alternative Assessment Resource Center for Teachers (EPSS) Prototype 1.0.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Prototype

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Title:

Constructivist Values and Emerging Technologies: Transforming Classrooms into Learning Environments

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Abstract

This article lists and briefly defines fourteen values that summarize the constructivist framework. It is suggested that the values provide a basis for evaluating instructional strategies aimed at fostering higher-order thinking skills and positive disposition toward learning. It is further suggested that the values may lead to a set of guidelines for developing a wide variety of learning environments.

Constructivist Values and Emerging Technologies: Transforming Classrooms into Learning Environments

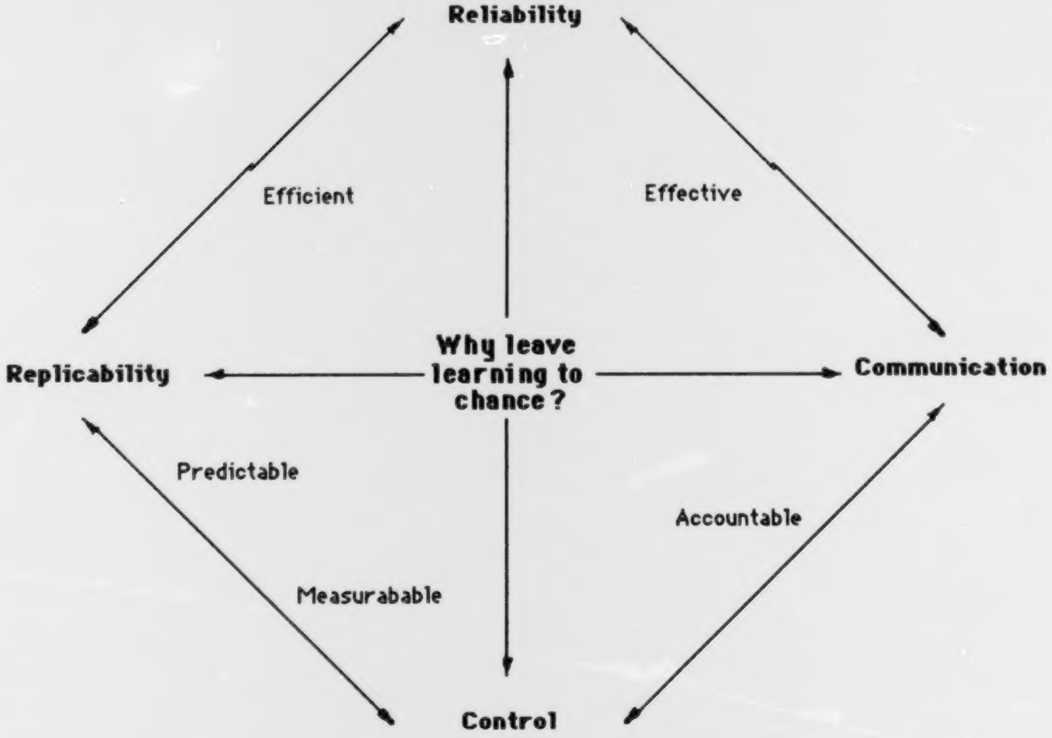
As emerging technologies offer the potential for designing highly engaging, student-centered learning environments and as the theory base for situated learning matures, a number of educational approaches have evolved that foster higher-order thinking skills and positive disposition toward learning. These include cognitive apprenticeship (Brown, Collins, & Duguid, 1989), anchored instruction (CTGV, 1990), The Community of Learners (Brown & Campione, 1990), and Computer-Supported Intentional Learning Environments (Bereiter & Scardamalia, 1992), to name a few. The educational problem that this paper addresses is how to summarize the constructivist framework reflected in these and related approaches, in a way that provides educators with manageable guidelines for transforming classrooms into computer-supported learning environments.

For purposes of the current presentation, higher-order thinking includes activities such as (a) critical thinking, defined as the process of figuring out what to believe or do about a problem for which no single definitive answer exists and as the process of evaluating the quality of text and other intellectual products, including one's own (Brown & Campione, 1990), (b) generative thinking, defined as the active process of using existing knowledge to make sense of new information necessary for meaningful learning, defined as the transition from declarative knowledge to use-oriented knowledge (Wittrock, 1991; Bransford & Vye, 1989), (c) problem-solving processes, defined as the application of current knowledge to delineate and think out a solution to a novel problem (Gagne, 1984), and (d) the use of cognitive and metacognitive strategies for achieving learning goals and exercising executive control of concentration, comprehension, and affect (Weinstein & Mayer, 1986; Corno, 1986, Shuell, 1986).

Positive disposition toward learning refers to individual differences in personal agency and learning orientation that influence students' perceptions of the learning situation, the quality of their cognitive engagement, and whether their learning activities lead to meaningful learning. Personal agency is the tendency for people "to take responsibility for their actions and ascribe success and failure to the goals they choose, the resources they mobilize, and the effort they expend" (Paris and Byrnes, 1989, p. 177). Learning orientation includes an individual's beliefs about the nature of knowledge and how it is acquired, the type of goal pursued by the individual on cognitive tasks, and the individual's perceptions about task requirements. It encompasses expectations, feelings, intuitions, attitudes, values, interests, intentions, significant relationships, and commitments (Vermunt, 1989).

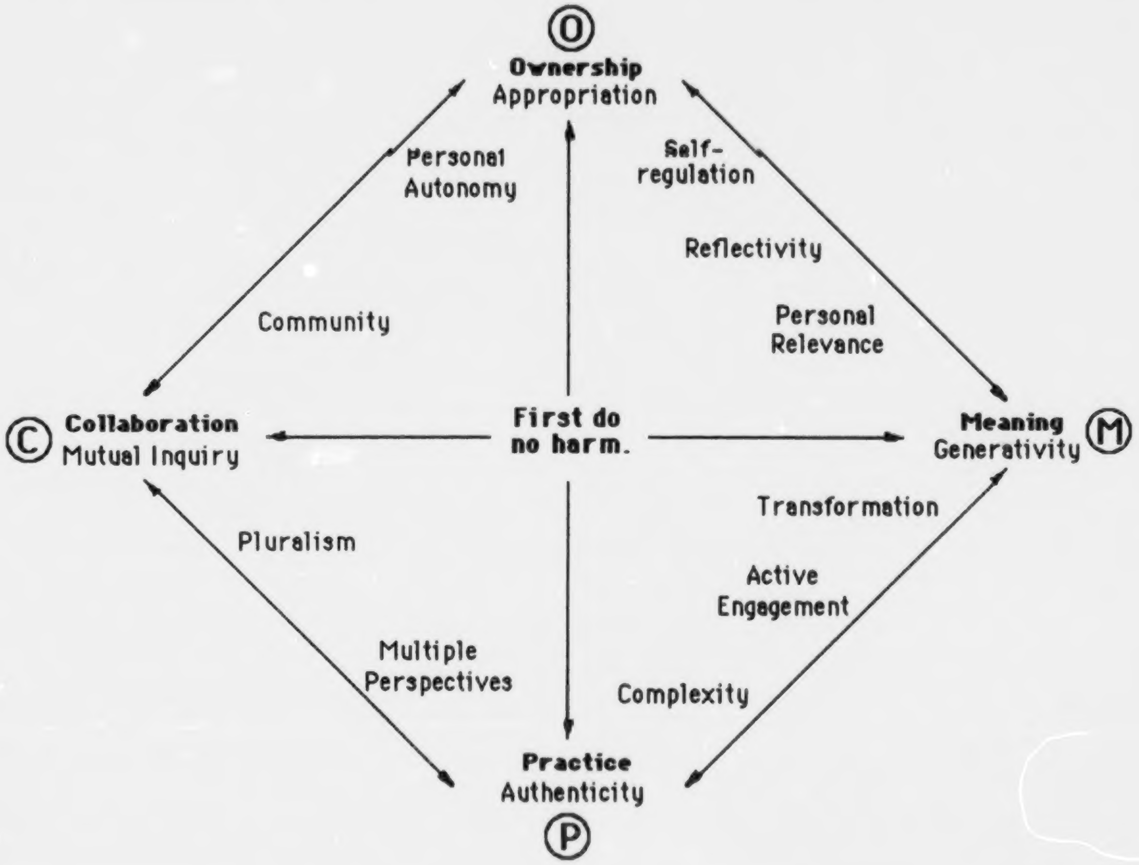
Eisner (1988) has observed that the values we hold as educators influence our students in ways that crucially affect their development. He has proposed that "the methods we espouse, the way we define knowledge, the work we regard as respectable, reflect our conceptions of virtue, and the courses we teach, in turn, are designed to help students achieve such virtues" (p.19). Taylor and Swartz (1988) have argued that educational technology is not as value-neutral a method of conveying instructional information as has been commonly believed. Rather, educational technology has generally supported a set of values identified by Heinich (1984) as replicability, reliability, communication, and control (see Figure 1).

Figure 1. Contemporary values of educational technology as identified by Heinich, (1984).


Reliability
Efficient
Effective
Replicability
Why leave learning to chance?
Communication
Predictable
Accountable
Measurabable
Control

In the face of what Doll (1989) has described as an emerging post-modern agenda for curriculum, an alternative (but not necessarily mutually exclusive) set of values has appeared (see figure 2). These values, as defined in the following section, come primarily from a review of literature in the areas of constructivist principles of teaching and learning, contemporary learning theories, achievement motivation (especially goal theory), collaborative learning environments, and the role of computers and related technology in education.

Figure 2. COMP: Constructivist values for developing higher-order thinking skills and positive disposition toward learning.



O
Ownership
Appropriation
Personal Autonomy
Self-regulation
Reflectivity
Community
Personal Relevance
C
Collaboration
Mutual Inquiry
First do no harm.
Meaning
Generativity
M
Transformation
Pluralism
Active Engagement
Multiple Perspectives
Complexity
Practice
Authenticity
P

It should be noted that many of the values are consonant with elements of both experiential education, as advocated by Dewey (1972) and the progressive educators of the 1920s and 30s, and humanistic learning theory, as championed by Rogers (1963) and Maslow (1968).

1. Active engagement. A quality of mindfulness in learning situations that supports intentional learning by influencing the learning strategies the individual employs. Intentional learning refers to cognitive processes that involve purposeful processing of information to achieve a learning goal actively desired by the learner (Bereiter & Scardamalia, 1989).

2. Authenticity. A characteristic of learning environments that are designed to develop understanding through application and manipulation of knowledge within the context of the ordinary practices of the target culture (Brown et al., 1989). Authenticity is concerned not only with the similarity of the learning situation to the transfer environment, but also with the value learners attribute to the learning task and whether the learner practices what is essential for the transfer situation.

3. Collaboration. Various noncompetitive social interactions that affect cognitive development, viewed on a two dimensional scale ranging from high to low levels of united effort and continuous sharing and from symmetric to highly asymmetric relative expertise of participants (Granott, 1993). When mutual inquiry is the general framework for learning, traditional roles of teacher and student are largely replaced by a collaborative partnership in a many-sided inquiry into meaning (Doll, 1989).

4. Community. The emphasis in various conceptions of affiliated work that focus on jointly constructed public knowledge as opposed to individual knowledge (Brown & Campione, 1990). This

orientation represents a fundamental change in education, where the goal is to transform classrooms into knowledge-building communities that allow students to contribute to each other's learning through the social construction of communal knowledge (Bereiter & Scardamalia, 1992).

5. Complexity. The view that reality is web-like, with multiple interacting forces (Doll, 1989) and that many areas of human endeavor, particularly those involving interaction between people, are ill-structured and characterized by a high degree of concept and case complexity and across-case irregularity (Spiro, Feltovich, Jacobson, & Coulson, 1991).

6. Generativity. The active process of using existing knowledge to make sense of new information necessary for meaningful learning. In generative teaching for understanding, the teacher's role is to help students build connections between their knowledge, beliefs, and experience on the one hand, and school subject matter on the other. Within this model, comprehension depends on the activities of the learner during instruction. The learner creates relations between prior knowledge and current experience by applying learning strategies such as elaborating with analogies, making inferences, paraphrasing, and summarizing (Wittrock, 1991).

7. Multiple perspectives. Experiencing the same material in a variety of different ways and for different purposes. Students develop flexible knowledge by experiencing multiple cases from multiple perspectives (Spiro et al., 1991).

8. Ownership. Experiencing the value of new understanding and the benefits of personal agency in developing commitment to meaningful learning goals and the ability to achieve these goals through self-regulation of the learning process.

9. Personal autonomy. The quality or condition of feeling in charge of the learning process as opposed to expecting others to direct it. Support of autonomy (as opposed to control) by providing choice, minimizing performance pressure, and encouraging initiation tends to support intrinsic motivation, meaningful learning, self-esteem and a variety of other factors relevant to the initiation and regulation of intentional learning (Deci & Ryan, 1987).

10. Personal relevance. Experiencing changes in perceptions, understandings, beliefs, feelings, and capabilities as a function of new information (as opposed to being told about its relevance). An individual's orientation toward learning is qualitatively different when learning is embedded in the context of achieving personally relevant goals that go beyond working for a grade or some distant, future goal (Berliner, 1992; Bransford, Franks, Vye, & Sherwood, 1989).

11. Pluralism. The belief that no single view of reality can explain all the phenomena of life, and, therefore, reality is, ultimately, the product of intersubjective agreement. From this perspective, each individual's perceptions have value and represent a basis for mutual inquiry, rather than an obstacle to be maneuvered around (Doll, 1989).

12. Reflectivity. Largely synonymous with metacognitive awareness, defined as the ability to plan, monitor, and modify cognitive processes for mental management or executive control of concentration, comprehension, and affect (Corno, 1986; Osman & Hannafin, 1992; Shuell, 1986). Students become increasingly responsible for learning through strategic exploration of errors and thoughtful consideration of their own and others' knowledge-construction activities.

13. Self-regulation. A form of cognitive engagement involving metacognitive, motivational, and behavioral dimensions for assuming personal responsibility for learning (Corno & Mandinach 1983; Zimmerman, 1989). Constructivists hold that the ultimate goal of education is to help students become masters of their own learning by supporting the progressive acquisition of the capability to self-regulate learning.

14. Transformation. A view of change that sees meaningful learning as the result of internal reorganization triggered by the learner or by the learner's reaction to external forces rather than a process of accumulating information in memory (Doll, 1989).

The development of guidelines based on this set of values represents a strategy for summarizing the constructivist framework in a way that can lead to a wide variety of learning environments and further provides a basis for evaluating instructional strategies (Savery & Duffy, in press). From another perspective, these values are concerned with epistemology, which as Bateson (1972) has suggested, ultimately defines the kind of world we live in.

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Title:

Neighbors On Line: Enhancing Global Perspectives and Cultural Sharing with the Internet

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The purpose of this study was to investigate the status of computer usage within Korean and United States schools, and then use the internet to establish cross cultural communications between schools. We hope that through this international communication using the internet, students at the elementary, junior high, and high school levels will gain deeper knowledge about other cultures and develop higher order thinking skills as they engage in collaborative projects. The Internet allows people to use computers to communicate by using the existing telephone lines; messages can be sent and received between various parts of the world, wherever the telephone lines travel and Internet access has been obtained.

After numerous planning meetings and site visits to schools, this project is in the preliminary stages of Internet communications between students. Eventually, we hope students can travel to visit their counterpart schools and thus have first hand experience within another culture. This cross cultural use of the internet has great potential to enhance the richness of student knowledge and thinking by allowing multiple ideas to flow from different perspectives, while developing multicultural sharing and acceptance from a young age, thus circumventing some of the preconceived prejudices found in the world today. Such understanding and tolerance can most certainly influence future political, business, and educational decisions, and policies. This goal goes far beyond the current attempts at understanding world news and cultural events from an isolated standpoint.

The sharing that can take place between students in the different countries has the potential to develop collaboration at an entirely different level than has been possible in the past. Although there potentially have been other projects in the past that might have encouraged such inter-cultural communication, they have been largely limited to print or video based efforts, and have had delays in both the type and speed at which communication could take place. The internet allows the most immediately interactive method of collaboration at a distance, that transcends past efforts by allowing students to take on joint efforts on projects. For example, students might engage in interactive school policy discussions, or perhaps design together a project that in the end reflects characteristics of different styles of the different countries involved. Such a project would reflect a truly multicultural result for no matter what the topic, students could bring their own perspective to the task and thus the input would represent multicultural thinking. The potential impact of different viewpoints, artistic expression, value systems, and so on offered through such a project could result in thinking that goes beyond that possible within a more limited setting. Further, you can imagine the difference between studying about Eastern or Western cultures by using traditional methods versus having current cultural information provided by one's peer age group that lives within the other culture. For example, the study of music would no longer be limited to the music classroom or traditional musical forms associated with any particular culture, but could include the favorite popular music and artists as recognized by each country's current youth; a new car design could contain some of the features currently found on cars within each country; discussions on social policy could bring explanations of the background reasons for particular customs or viewpoints; and anthropological information such as viewpoints on aging and family units could bring a deeper understanding of other cultures.

Since the 1970s, schools in the United States have struggled to find meaningful ways to implement computers in order to respond to a societal need to develop computer literacy along with skill in using the newly available information technologies. These technologies are changing rapidly and schools are struggling to keep abreast of those changes. Thus many schools are interested in expanding their activities to include more challenging and educationally meaningful experiences for students that will translate directly into building higher levels of thinking and better skills at using the newly available and powerful information technologies. Telecommunications has been an important method of offering distance education for adult and high school audiences over the past several years, but very little has been done using the internet for these audiences and very little has been attempted to create educational opportunities for elementary and middle school students using telecommunications. One goal of this project was to establish an international communications link between school students at the elementary, junior high, and high school levels, thus empowering students to go beyond the traditional curriculum and gain education in a different way.

The important issues surrounding educational computing have changed over the past decade as the technology and access to it have improved. When computers were first placed in U.S. schools, the questions focused on how to get more hardware and software. Then, as more and better equipment became available, the focus shifted attention to the best way to implement computers for educationally rich experiences. Databases have made huge caches of information available to students and the teaching process itself has shifted to focus on building higher order thinking and research skills, changing the very nature of the teacher's job.

As the schools struggle to find meaningful uses for computers, the technology often drives the curriculum effort (Knupfer, 1993). It is apparent that the curriculum needs should lead the technological efforts, but the technology offers unique opportunities that go beyond the original curriculum plans. Many countries wrestle with these issues.

In the mid 1980s Korea began to implement computers to promote information technology skills in schools. In Korea, the effort was led by social forces, much the same as in the U.S. But what stage is Korea at now? How far have U.S. schools progressed with information technologies? Which country is leading the telecommunications efforts? Both countries have produced leaders in researching and implementing educational computing, and scores of Korean teachers have pursued graduate studies in U.S. universities to gain knowledge about educational communications and technology. How do the countries compare in their current activities and efforts within the schools? What similarities and differences help or hinder their efforts? What can we learn from each other, now that we can communicate via the internet communications system? What new experiences can we offer our students for learning about another country and culture, and applying higher order thinking to meaningful inter-cultural exchange?

This paper attempts to answer some of those questions as it reports about some current efforts of schools in Korea and the United States. Specifically, the remainder of this paper will describe the Asian Link: Telecommunications for the 21st Century project and some efforts within the state of Kansas to get schools online.

Asian Link : Telecommunications for the 21st Century

The *Asian Link: Telecommunications for the 21st Century* project was initiated by the Australian Asian Education Foundation which was founded to introduce Australia to Asian countries and Asian countries to Australia through education. They wanted to conduct this mission through interesting and exciting methods, and internet telecommunications received the attention due to its convenience and economic outlook. While the use of telecommunications, particularly international telecommunications such as that offered by the internet, was actively applied in tertiary education, primary and secondary education also can greatly benefit from it. Such experience will be the basis for creating a model which at the beginning stage will facilitate closer ties between Korean schools and other schools in Asia, Australia, and the United States of America.

The purpose of this international project is to investigate how to apply telecommunication technology in K-12 education. Instructional activities through the telecommunication technology can encourage cooperative learning environment because activities in this project are based on the students' choice and consensus among partners from the school of foreign countries. It is all based on such democratic processes.

Participating	**Countries and Supporting Organizations**
• Korea:	Korea Educational Development Institute
• USA:	Copen Family Fund, Korea Society I#EARN (International Education and Research Network)
• Australia:	Asia Education Foundation (AEF), Australia Korea Foundation I#EARN Australia
• Japan:	Association for Promotion of International Co-operation in Tokyo
• China:	Chinese Institute of Educational Research in Beading

What Schools Need to Prepare

- Staff and student ideas
- Staff that includes a group of teachers, especially an English teacher and computer teacher or a teacher proficient in the use of computers,
- Other teachers of any subject with passion on this approach
- A computer and telecommunication software
- A modem and phone line
- Teleconferencing facilities (Lumba video phone - slow scan black & white phone, not essential)
- Subscription to I#EARN (International Education And Resource Network)

The computer and phone lines are encouraged to be situated in classrooms. That is essential if the computer is to be viewed as an integral part of what is done on a daily in classes. I#EARN is designed to create an educational framework specifically for classroom teachers to utilize the vast resources available through these global networks. I#EARN was created by the Copen Family Fund in 1990, working closely with affiliate telecommunications networks of the Association for Progressive Communications (APC) system and a number of educational organizations. Each participating school has two internet IDs assigned by KEDI and one APC user identification (ID) supported by the Copen Family Fund. (The list of IDs for each school is listed in the appendix.)

Instructional Activities: Research Content

What is important is the individual subject area, not the computer or the technology. Telecommunication should be accepted as an educational media to empower students and teachers, thus hopefully elevate the quality of education. Given the enormity of global telecommunications networks, it would be a daunting task (but not impossible) for an individual teacher to develop the familiarity and contacts to create meaningful and relevant networks to both their subject areas and student interests.

Instructional activities are not fixed; they are up to the participants. To promote cultural awareness, to integrate telecommunications into foreign language study at an early age, and to support inter-curricular activities, cooperative project based programs are among encouraged.

How Students And Teachers Work Through APC Net

The participating schools are paired and encouraged to correspond to those one-to-one partnership schools. However, they are also open to communicate with other I#EARN schools over the world (approximately more than 400 schools from 23 countries).
Participating students and teachers use conference rooms on APC network such as AEF.ideas, AEF.teachers, and AEF.students in order to exchange project ideas. Ideas are tossed to those conferences and anyone who are interested in that idea can join the project.

This communication is to establish a long term relationship and hopefully result in exchanges and other forms of collaborative learning. As a result of this project, Ahyun Middle School (one of the participating schools in Korea) sent 31 students and 4 teachers to their partner school, Castle Hill High School, in Sydney, Australia. For the return visit, students and teachers of Castle Hill High School will visit Ahyun Middle School next year and they already started their preparation such as to offer classes for Korean language which is one of their four major foreign languages regulated by the Australian government curriculum.

The Difficulties Of Participating Schools Experience

There are numerous obstacles to implementing the internet technology in education in Korea including the following:

1. Shortage of a phone line for networking

Generally public schools have two three phone lines for the whole school. While the phone line is so scare resource, it is difficult to keep a line for long for networking. In most of the schools, the hardware facilities for networking such as a computer and modem for networking is not a problem but installation of a new designated phone line for the networking creates problems like fare distribution of school resources and maintenance fee monthly.

2. Language barrier

English is the second language and in fact to Koreans learning English is almost the most difficult language to learn. Those students in middle school who just started to learn English can experience difficulties in expressing themselves in the foreign language. In Korea, English is taught from the middle school, thus elementary students do not even start to learn English. Teachers have the same language problem. Although English teachers are encouraged in join this project, their support is limited.

3. Speed of networking

In local networking, speed is not such a problem. But when it is the international networking, the speed becomes a problem. Particularly for multimedia data networking (WWW networking), it is so slow that schools can not afford the phone bills. It is more of an infrastructural problem in Korea.

4. Limited ID for Individual students

For this project, KEDI provided two internet IDs, one for a teacher and another for students. I#EARN distributed one ID for each institute. Thus, students write and send it to the teachers so that the teachers can handle the data. It creates the situation where students do not take care of their letters directly. It looses their feeling of control.

5. Technical training for teachers

For teachers, networking is very foreign. It requires some technical skills. More time and training are required until they feel comfortable to use the internet.

6. Integration into the curriculum

Internet networking is fun to use but difficult to interweave the fun into the existing curriculum as a meaningful instructional activity.

7. Discontinuity of project among teachers

Due to the short turn around period for teachers (in Korea, every three or four years, all the teachers at the public schools whose status are public servants are obligated to change schools to prevent the stagnation of being in one place too long and experience and share their specialties in different settings), the project can lose the continuity among participating partner schools. Once the teacher in charge or the principal are appointed to another school, it is difficult to expect to keep the relationship between the partner schools.

While internet implementation during the instruction is initially practiced and many problems are first noticed, its educational value is apparent. It motivates students and teachers very much and brings the real world into the class, introducing international culture and society in a natural manner. Both students and teachers truly feel they are living in a global village.

Sample I#EARN Projects

I#EARN has been involved with many projects that reflect issues of global interest and social concern. Certainly as the internet communication expands, the list of I#EARN projects will expand as well. The following projects are a partial listing of those completed since August 1992.

- The Contemporary, a news magazine
- A Vision, a literary anthology
- Water Pumps for Nicaragua
- Somalia Relief
- The Holocaust Project
- The Heroes Project, a hero identification project for children
- Water Monitoring Project
- First 100 Days of the Clinton Administration
- Holiday's Project
- A Current Events Seminar

Social Implications

Many positive social outcomes are likely to emerge from this project and we hope to see students realize the fullest potential of data retrieval and shared communication capabilities of the internet. However, wisdom dictates that responsible educators anticipate and try to avoid potential social problems that might emerge as hidden issues.

Some of the social issues inherent within this project could emerge as the project develops and so we will mention a few of the more obvious ones here. First the numbers of students and teachers who can participate are limited. Although the specific numbers vary from school to school, the number of students who can be involved at each school ranges at about 20-30 students, who are selected by the teachers, thus the majority of students do not have the opportunity to participate in this project. Students are limited in numbers because basically, this project is not part of the regular curriculum.

Funding remains a problem at the individual student level and at the school level. At this time, individual students must accept the responsibility of payment for any travel and so, students are limited by their family's financial status.

Schools have limited money for the telephone lines and so the lines are used for other purposes in addition to the internet project. Because teachers have difficulty accessing the telephone lines during the school day when they are needed for voice communication, the teachers find themselves extending their work day into the evening hours to work when no one else needs the telephone line. Although some schools could obtain less expensive access to the internet through local universities, training then becomes an issue. Currently KEDI provides training on a common access system, but it schools choose to access the internet through a local university, then system training would need to be offered by that university.

Internet access offers communication opportunities that have mixed results. There is the potential of emerging personal relationships which could have positive or negative effects. Also, there are concerns about access to pornographic material for students who use the internet. Questions have emerged about whether the balance of males and females involved with the project will be representative of the student population at each school. Ethical considerations must be addressed concerning the responsibility of the teacher, the safety of students, and the potential of virtual relationships to develop productively. In general, teachers need to make some judgments about the wisdom and guidance necessary for unrestricted access to the internet resources.

KANSAS EFFORTS

Internet communication in Kansas schools has been led by two driving forces, the individual teachers and funding. Like the computing efforts of the past decade (Knupfer, 1993), internet telecommunications is most likely to occur where interested teachers make a grassroots effort to gain access to the resource.

Information Network of Kansas (INK)

The Information Network of Kansas (INK) was activated in 1992 in an effort to provide on-line services to people throughout Kansas. Within the INK network there is information concerning legislative, banking, legal, insurance, business and commerce, library, State agency services, local government, electronic mail, children's services, and customer utilities. Initially, access to INK was available to schools for an annual subscription fee of $50.00 plus a connect time charge of $.40 per minute after the first minute. Now the annual subscription fee has jumped to $180 per year plus a line charge of $7.20 per hour of use, plus the long distance connect time charge. If a school has access to a computer, modem, telecommunications software, and a telephone line, then it can access INK.

Unfortunately, the funding could not keep pace with the huge on-line charges that began accumulating as more and more schools began to use the services at ever-increasing levels. For many rural districts who were not within access to an internet hub by through a local telephone call, the INK became a primary resource. And, rather than que files and set them up to run in batch mode to minimize connection time, schools found their usage did not conform to that option. Instead, students and teachers were performing on-line, interactive database searches that required lengthy connections. Now schools are finding the accumulating cost to be a burden and school usage of INK is in jeopardy.

Link 19

Link 19 is another on-line service that is free to Instructional Television (ITV) members, beginning Fall 1994. Link 19 is a powerful computer-based information and communications network that provides access to educational resources, including the internet, bulletin boards, newsgroups, discussion centers, and Sharenet. Those school districts with full subscriptions to ITV service qualify for three free connections to Link 19. Less than full, regular subscription to ITV would make a district eligible for one connection at most within the district. Extra accounts can be purchased at an additional charge. At first, Link 19 offered one hour free access per day for each school, then that was decreased to one hour per day for three sites per school district, and currently the policy seems to be fluctuating down and up.

American On-line

Many Kansas schools are finding that American On-Line (AOL) is one of the better commercial services available for those who have a local number to call. Unfortunately the many rural schools in Kansas do not have access to an AOL hub by a local telephone number. The cost of AOL itself is $9.95 per month, plus any line charge for long distance calls, plus $2.95 per hour. AOL provides full internet service plus a host of special services.

Direct Connection to Internet

Schools that wish to have a direct connection to the internet will pay a minimum of $5,800 per year for the service, plus any long distance fee to access the nearest hub. The direct connection could be beneficial to some schools, while others would find the additional fees overwhelming.

DISCUSSION

Financial difficulties that result in limited access to software and service providers have been the most difficult problem for Kansas schools in the telecommunications effort. Finding the right provider with appropriate and affordable services is difficult and so schools are struggling to find funding for the services. It is possible that centralized control over pricing and access that is negotiated for all Kansas schools could help, but currently local control means a variety of situations and inequitable opportunities, based upon the local service provider's policies, the schools ability to afford the service, and the schools distance from a local telephone call to the internet.

Although all schools could potentially have access to the internet and communicate globally, the reality is that the rural districts cannot afford such activity on a regular basis due to the long distance telephone charges. Schools that are within local calling distance from a main AOL hub or a university internet connection have better access at a far reduced price. Many rural teachers are investigating the potential of getting sponsorship support from local businesses, but that is not an easy commitment to secure without definite cost projections on a long-term basis. So many students will continue to wait for additional funding in order to join the internet community. One key difference between Korean schools and Kansas schools is the provision of the internet ID by a central source in Korea.

Of course, the continuing problems that have plagued teachers during the course of the technological revolution continue as computing moves into the telecommunications and internet arena. Two pressing problems reported previously, shortage of training and time (Knupfer, 1989-90) continue as concerns. The internet presents an area of access to a wide variety of resources and teachers will need some training and preparation time to adequately attend to this resource in a practical and meaningful way. Two excellent sources of information for teachers about how to implement internet telecommunications within the classroom are *TeleSensations: The Educators' Handbook to Instructional Computing*, by Andres, Jacks, and Rogers (1991 and *Integrating Telecommunications into Education*, by Roberts, Blakeslee, Brown, and Lenk (1990).

If Kansas schools are to communicate with Korean schools, a third problem that they might encounter is language. Although many students study second languages in school, Korean is a language that is rarely offered within a public school setting. Foreign language classes have suffered as the lack of qualified teachers and funding have combined to create a shortage of on-site language courses. Schools in Kansas are limiting their choices of foreign language to those in greatest demand, usually Spanish, and are offering those classes increasingly via distance education. This situation makes it highly unlikely that additional foreign language courses will be offered unless something happens to change the perceived need for foreign language with respect to the rest of the curriculum. One could speculate that schools should place more emphasis on foreign language as the improved communications promotes world wide communication. However, as we can see from the Australian and Korean experience, many countries offer English as a second language; this of course, makes English the easiest route for schools in the United States and does not apply pressure to reconsider decisions along that line.

In Kansas, there are many teachers and students who are eager to join in the telecommunications with Korean schools. However, they struggle with the ability to do so. If Kansas students are to keep abreast of the changes in education, then they will need to be allowed to participate in activities beyond the scope of the existing curriculum within the existing school structure. Liberating the students to access the internet will provide a world of opportunity for them that will only begin with the international school communication.

The potential of the internet communications for shared projects among these students in different countries is enormous. Naturally, schools face social and cultural implications that result because of access to the internet and its potential to change the educational system, whether communication goes beyond the boundaries of a country or simply beyond the boundaries of a school. The internet truly has the ability to empower teachers and students to strike out beyond the traditional curriculum to change the very nature of their topics of study, the methods by which they study them, and the result of the educational process.

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APPENDIX

KOREAN SCHOOLS	KEDI ID	IGC ID	PARTNER SCHOOL	IGC ID
1. Pohang East Elem. Mr. Jaekon Park	poet poes	pohangeast	Sunnyside Elementary	sunnyside
2. Pohang West Elem. Mr. Pankun Kim	powt pows	pohangwest	Kimball Elementary	kimball
3. Ahyun Middle Mr. Sujong Lee	ahyunt ahyuns	ahyun	Castle Hill High (Au) Covington Jr High	castlehs covington
4. Yangjeung High Mr. Yongkwon Cho	yangt yangs	yangjeung	Capital High McKinnon Secon Col(Au)	capitalhs mckinnon
5. Kunkuk High Mr. Sangul Lee	kunt kuns	kungkook	South Bronx High	sbhs
6. Suhgui High Mr. Kitae Pyun	suhguit suhguis	suhguinong	Kaimuki High	
7. Junju High Mr. Unkyun Paek	junjut junjus	junju	Sammamish High	sammamishhs
8. KEDI	ohlee	kedi	Dr. Okhwa Lee	

*All IGC ID requires @igc.apc.org to be the full name except the school of Australia.
Aussi schools have @peg.pegasus.oz.au

*All KEDI ID requires @ns.kedi.re.kr Eafter the account for the full name.

Title:

The Reformation in Foreign Language Instruction

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INTRODUCTION

The call for more authentic communication in the language classroom has led to an increasing use of technology. Although technology is a good tool to teach language and culture, it is not yet commonly used by foreign language instructors.

This article reports on how foreign language instructors at Arizona State University at Tempe are encouraged and taught to use technology in their teaching. Section one introduces the reasons why technology is helpful for foreign language instruction. Section two describes foreign language instructors' attitude toward using technology in their teaching. Section three depicts the efforts of the Foreign Language Department at Arizona State University to improve its teaching via technology. In this section, the renovated labs and a two-week language technology workshop are described as well as a study about the instructors' attitude toward using technologies and their self-assessment of some technologies. Finally, further research topics are suggested.

TECHNOLOGIES TO FOREIGN LANGUAGE TEACHING

A common complaint of foreign language students is that they can not communicate with native speakers after they have studied the language for several years. During the last decades, the Grammar Translation teaching method, which stresses students' spelling, reading, translating, and writing ability, has been replaced by the communicative method of language teaching, which considers oral communication as the ultimate goal of language teaching (Celce-Murcia & McIntosh, 1984; Long & Richards, 1987). This approach emphasizes that the language that is taught is of a functional nature, spoken in a natural and informal manner (Slaton, 1989).

Instructors using the communicative method are preparing learners to survive in the target language environment; therefore, students need to be exposed to authentic materials in order to be able to react appropriately in real situations. Technologies make this possible; videotape and videodisc enable learners to listen to the authentic language that is used in real situations. Also, they allow learners to be exposed to the verbal and non-verbal behaviors of the foreign culture, such as greeting (Schneider, 1982). Saint-Leon (1988) indicated that videodisc is a good way to introduce culture. Computer networks, such as E-mail, enable learners to have direct contact with native speakers by writing (Sayers, 1987) and videoconferencing encourages the oral communication between foreign language students and target language speakers (Herbst & Wiesner, 1988).

Besides the goal of the instruction, the linguistic proficiency of a teacher explains why technology is beneficial for foreign language teaching. If a teacher's speech is really fluent, grammatically correct, and untainted by a foreign accent, then the student is truly fortunate (Schneider, 1982); however, in reality, very few teachers are so competent. Then native speakers' language which can be found on audio tapes, videotapes, and videodisks would be advantageous.

Moreover, the pedagogical proficiency of a foreign language teacher is limited to certain extent no matter how experienced the teacher is (Schneider, 1982). S/he might go too quick or too slow. However, the computer-assisted instruction (CAI) allows students to learn a language at their own pace. Furthermore, because different teachers have different criteria for students' answers and different attitudes toward students' errors, the students' learning can be affected. Technology allows a learner's mistakes to be a secret between the learner and the computer. Thus, learners are not discouraged.

The levels of students also explain why technology is helpful in foreign language teaching (Schneider, 1982). It happens frequently that in a class the ability of some students is high and that of others is low. All students can benefit from technology-based instruction that is interactive and individualized.

From the above, we see that, considering the instructional goal, teachers' proficiency, and students' competence levels, technology is useful in foreign language instruction.

FOREIGN LANGUAGE INSTRUCTORS' ATTITUDE TOWARD USING TECHNOLOGY

Foreign language instructors are in favor of using technology in their teaching because technology provides authentic teaching materials and allows learners to be exposed more fully to cultures of target languages (Hill, 1991; Herbst & Wiesner, 1992). Nevertheless, currently few instructors use technology in their teaching. They are afraid because they are not familiar with it. They also do not have enough access to equipment.

Suki Heath conducted a survey to find out what teachers thought about authentic (satellite) television, and how widely it was being used (Hill, 1991). Ninety-three percent of the respondents stated that they would like to use authentic television more than they do at present. One striking theme to emerge from the survey was "the almost unanimous enthusiasm for authentic television" (p. 10). However, "Lack of available material, inadequate access to equipment . . . were the most frequently quoted constraints" (p. 10).

Saint-Leon (1988) found that ". . . using authentic materials requires that the teaching be adjusted to the materials rather than the materials to the teaching. Such an approach goes against tradition in many ways and therefore requires considerable adjustment" (p. 38). She also pointed out that instructors often have difficulty integrating the video programs into the curriculum.

From the above, we see that foreign language instructors have a positive attitude toward using technology in their teaching. Nevertheless, they need to be provided with the necessary equipment and have to be trained how to use technology effectively and how to integrate it into their instruction.

THE REFORMATION AT ARIZONA STATE UNIVERSITY

Due to the need to integrate technology with language teaching, the Foreign Language Department at Arizona State University renovated the language learning lab in 1992. The new labs were effective in spring of 1994. In summer of 1994, a technology language workshop was held to train the instructors in this department.

The Renovated Labs

The new language learning technologies include an audio-visual lab, a language computing lab, and six mediated classrooms. These technologies not only allow students to learn languages by using multimedia software, but also enable instructors to develop multimedia programs.

The Audio-Visual Lab

Fifty-six booths are in this lab and each booth has an audio control panel and a video monitor. Students' cassette tape recorders are in a separate room where the instructors can simultaneously duplicate 56 cassette tapes at high speed. Before class, an instructor can quickly download material into the students' tapes. The audio control panel in each booth allows the student to control his (her) tape. Of course, the instructor can control the students' activities whenever he (she) wants to.

A student can learn a language not only by listening, but also can learn the culture by watching a video on a video monitor. There is a "hot seat" among every four students in the same row. The student on the "hot seat" has a video control panel that allows him (her) to control the video images on the monitors of the four students. S/he can freely rewind a videotape and have a small group discussion with the other three learners.

The Language Computing Lab

Fifty-six computers locate in this lab and each computer has a headphone and a CD-ROM drive. Students can view multimedia programs, write E-mail, and search for information in Internet via Gopher, Mosaic and Netscape. Toolbook packages for learning different languages are available in this lab. The equipment here also allows instructors to design and produce their own instruction.

A special equipment, the TECH Commander, allows an instructor to view the screen of an individual student and take control of the screen. Thus, the teacher and the learner can watch the same screen and discuss what is on the screen by headphones. The instructor can also let students view what is on his/er screen and provide instruction. A computer with a video overlay card and the TECH Commander enables all students to watch a videotape program on their computer screens. A special software installed in some computers allows students with visual problems to enlarge letters on their monitors, and some hardware also is provided for hearing-impaired learners.

The Mediated Classrooms

A mediated classroom consists of a multimedia computer, a video monitor, and a video projector. The Rauland-Borg Ranger Media Management System can distribute video and multimedia-computer capabilities to this classroom (on the second floor) from a control room (in the basement) where all material sources are stored. Thus, an instructor does not have to bring those sources (videotapes, laser discs, or CDs) to class, but s/he can control these materials. The other six mediated classrooms are about to be completed and all presentation materials will be generated and distributed from the control room by computer programs.

The Language Technology Workshop

Description

In addition to the renovation of the labs and classrooms, the department also held a workshop to train instructors to use these technologies in their teaching. The workshop was held by Dr. Dan Brink right after the semester ended, from May 16 to May 27, 1994. The purpose of the two-week workshop was to train the instructors in the Foreign Language Department to be aware of the new technologies and be willing to use them in their teaching. Instructors in the department were not required to take part in the workshop, but encouraged to attend, and coordinators of language sections were strongly recommended to participate in it.

Every day, the workshop began with an orientation meeting, followed by presentations and discussion from 9:00 a.m. to noon, and hands-on practice from 1:30 p.m. to 4:30 p.m. in the computer lab. In the afternoon, the instructors defined themselves as beginners or advanced learners and received different tasks which were related to what they learned in the morning. During the afternoon, Dr. Brink and two teaching assistants helped the instructors individually.

Toolbook and E-mail were the main focus of the workshop. Toolbook, like HyperCard, is an authoring program which allows instructors to design instruction. On the first morning, the presenter (Dr. Brink) introduced the workshop, the language learning labs and classrooms, Toolbook basics, and Internet basics. On the second day, the participants learned to operate the equipment in the mediated classroom, E-mail basics, and Toolbook primer. More E-mail and Toolbook basics were taught at the third session. On the fourth morning, the participants listened to a talk about using E-mail in Spanish classes, discussed their homework, and learned importing and screen design. On the last day of the first week, the participants watched some sample programs, learned about the Internet, and experienced multimedia.

The second week started with designing flowcharts and discussing a Toolbook project to teach passive voice. In the seventh session, a sample project of teaching French was demonstrated and getting sound into Toolbook was introduced. On the eighth morning, the participants got acquainted with the "humanistic" approach of language instruction and computer conferencing. The next day was devoted to colors, instructional design models, and sound clips. On the last day, some useful features of Toolbook such as scripts were introduced.

Participants

There were twelve participants in the workshop: one German professor, two Italian professors, two Spanish professors, four French professors, two ESL (English as a Second Language) professors, and one English Linguistic professor. Most of them are coordinators of different language sections and can considerably influence other instructors. They are experienced language professors; all but two have taught language for more than 10 years and five of them for even more than 25 years. Five of the twelve participants attended the workshop for one week and seven of them stayed for two weeks.

Getting acquainted with technology, improving teaching techniques, learning to develop language software, and incorporating technology into language teaching were the instructors' motivation to attend the workshop.

Methodology of the Study

Four questionnaires were distributed to the participants before, at the end of the first week, and at the end of the second week of the workshop. The first and second questionnaires, which were filled out by the participants before the workshop, were designed to check their technology background and attitude toward using technology in language teaching (see Questionnaire I & II in Appendix). The technologies mentioned in the questionnaires include E-Mail, computers, digital technology and analog technology. The participants ranked from one to five the strength of their attitude, one for the lowest and five for the highest.

At the end of the first week, the participants answered the third questionnaire that was to investigate their self-assessment of their learning in the first week. Their Toolbook and E-mail basics' familiarity, attitude of using these technologies in foreign language teaching, and feelings of using them in their own teaching were studied (see Questionnaire III in Appendix).

At the end of the workshop, the seven participants who stayed for the second week filled in the fourth questionnaire. This questionnaire was not only used to look at the self-assessment of their learning, but also used to compare their attitude toward using technologies in teaching before and after the workshop (see Questionnaire IV in Appendix).

The ranking numbers were averaged (see Tables in Appendix). The difference between the average of the first week and the second week was investigated. The tables also show the average of all respondents and the average of the participants who stayed for the second week.

Results & Discussion

The responses of the first questionnaire revealed that most of the participants were not familiar with the technology. Six of them (55%) knew nothing about E-Mail; four of them (36%) knew some E-Mail basics; only one of them (9%) was familiar with different systems of E-Mail. As to their general computer background, five of them (45%) did not know anything about computers; four of them (36%) knew some basics about Windows or Mac; one (9%) was well-versed with various applications, and one (9%) considered himself as a programmer. One professor did not respond to the questions.

The responses also showed that technology was not heavily used by the instructors. None of them used E-Mail in their teaching. Only one of them had studied instructional design or ever used digital technology; three of them employed analog technology in their teaching.

Although the participants were not familiar with technology and also did not use technology in their teaching significantly, their attitude toward using technology in language teaching was very positive. Table 1 in Appendix indicates that the participants ranked their attitude above average, when asked what they thought of using the technologies in language teaching before the workshop.

One professor responded, "It is necessary for the teacher to use it or to be old fashioned. We are in era of the technology." Another participant stated, "I think it can be very useful, even though I probably do not completely understand or know its full potential." Another professor answered, "I am anxious to incorporate this technology in my teaching. I think it will be extremely helpful."

Some professors preferred digital technology to analog technology because they could have access to images easily and obtain better quality images. One professor mentioned, "I prefer digital [technology] because I like something clear and neat." Another professor also expressed, "Sound quality [of the digital technology] is superior to [that of the] analog. . . . I get tired of cleaning tape recorder heads and still having bad quality, but it is easier to copy." Low cost and easy access are advantages of analog technology. A professor mentioned that analog technology is "cheap and readily available," but finding the exact segments s/he wanted is difficult.

The responses of the third questionnaire, which was filled out by the participants at the end of the first week, revealed that the instructors were not very confident about the knowledge they learned during that week. The average of Toolbook basics was 3.2 and the one of E-mail was only 2.8 (see Table 2 in Appendix). Nevertheless, the instructors' attitude about using the technologies in teaching was not affected by their knowledge about them. They had very positive attitude toward using Toolbook in language teaching and thought that they would use it in their own teaching.

The attitude toward using E-Mail was not as positive as the one toward using Toolbook because the subjects and levels that the participants teach would affect the instructors to use this technology. The linguistics professor said, "I'm not convinced that all-English-speaking classes in linguistics would benefit." Another professor stated, "It can be useful for some high classes." The professors who ranked it high thought that E-Mail allows learners to be exposed to cultures when students write to native speakers.

Seven professors stayed at the workshop in the second week. All of the average numbers in the third column of table 2 were higher than the ones in the first-week columns (see Table 2 in Appendix). These results indicate that these instructors felt more confident on their knowledge about Toolbook and E-mail at the end of the second week than at the end of the first week. The Toolbook familiarity average rose slightly from 3.0 to 3.4 and the average of the attitude also rose from 4.3 to 4.5. All of the respondents thought that they would use Toolbook in their own teaching at the end of the second week. The E-mail familiarity average jumped from 2.7 to 3.9, and the average of the attitude also rose from 3.9 to 4.3. The average of using E-mail in their own teaching went from 3.4 up to 3.9.

The results in Table 1 indicate that the instructors' general attitude toward using these technologies in language teaching after the workshop was not much different from the one before the workshop. The average of the instructors' attitude toward using E-mail in teaching slightly went from 4.0 to 4.3. Their average response to digital technology and analog technology before and after the workshop was about the same. The average of their attitude toward using computers dropped slightly from 4.5 down to 4.3. Since the difference was due to only one participant's response, the change was not considered significant. The researcher thought that the unchanged post-workshop attitude was due to the strong positive attitude the instructors had before the workshop. The majority of the participants thought that the workshop was helpful and similar workshops were needed in the future.

CONCLUSION

From the study, we can tell that the foreign language instructors were not familiar with technology and seldom use technology in their teaching before the workshop. However, they had very positive attitude toward using technology in language teaching. During the workshop, they gained general knowledge of technologies, such as Toolbook, Internet, instruction design, and multimedia. At the end of the workshop, they felt more comfortable about technology and had similar positive attitude toward using it in instruction.

Since the participants had very positive attitude toward technology before they attended the workshop, the study did not reveal the relationship between the participants' knowledge and attitude. It would be helpful for researchers to look at the correlation between instructors' technology knowledge and their attitude. To investigate the instructors' knowledge and attitude one year later would be interesting, too.

There were only twelve participants in this study. It would be beneficial to conduct research on more foreign language instructors to obtain a broader picture of foreign language instructors' familiarity of technology and their attitude toward using technology in teaching. More instructors' technology training programs need to be designed.

Appendix

Questionnaire 1

Language Technology Workshop
Participant Questionnaire:
Name: ____
E-Mail address: ______________________________________
Department, mailcode: _________________________________

Self-assessment of E-Mail familiarity (circle one):
none E-mail basics familiar with many systems guru

Have you ever used E-Mail in teaching? ____________
If so, give a brief description:

Self-assessment of computing familiarity (circle one):
none windows/Mac basics many applications programmer

Have you ever used a programming language? ____________
If so, which one(s):

Have you ever used digital technology in teaching? ___ ________
If so, describe what you did:

Have you ever made significant use of analog technology in teaching (other than visiting the language lab)? __________
If so, describe:

Have you ever studied instructional design? __________
If so, describe:

Which of these activities--or which other activity or activities--would you like to learn more about in this workshop?

Questionnaire 2

Language Technology Workshop
Participant questionnaire II:
Name: ____

What do you think of using E-mail in foreign language teaching? (circle one)
1 2 3 4 5
not useful very useful
Please describe your attitude:

What do you think of using computers in foreign language teaching? (circle one)
1 2 3 4 5
not useful very useful
Please describe your attitude:

What do you think of using digital technology in foreign language teaching? (circle one)
1 2 3 4 5
not useful very useful
Please describe your attitude:

What do you think of using analog technology in foreign language teaching? (circle one)
1 2 3 4 5
not useful very useful
Please describe your attitude:

Questionnaire 3

Language Technology Workshop Name: ______________________
Participant questionnaire III:

How long have you taught the language? ______________________

What is your main teaching area? (circle one)

language linguistics literature others:

Please describe your motivation of attending the workshop:

Toolbook and E-mail basics refer to what we learn this week.

Self assessment of Toolbook basics familiarity (circle one):

1	2	3	4	5
not good				very good

What do you think of using Toolbook in foreign language teaching (circle one)?

1	2	3	4	5
not good				very good

Are you going to design lessons using Toolbook in your teaching (circle one)?

1	2	3	4	5
not good				very good

Please explain:

Self assessment of E-mail basics familiarity (circle one):

1	2	3	4	5
not good				very good

What do you think of using E-mail in foreign language teaching (circle one)?

1	2	3	4	5
not good				very good

Are you going to use E-mail in your teaching (circle one)?

1	2	3	4	5
not good				very good

Please explain:

Questionnaire 4

Language Technology Workshop Name: ____________________________
Participant questionnaire IV:

Toolbook and E-mail basics refer to what we learned these two weeks.

Self assessment of Toolbook basics familiarity (circle one):

1	2	3	4	5
not good				very good

What do you think of using Toolbook in foreign language teaching (circle one)?

1	2	3	4	5
not useful				very useful

Are you going to design lessons using Toolbook in your teaching (circle one)?

1	2	3	4	5
not at all				definitely yes

Please explain:

Self assessment of E-mail basics familiarity (circle one):

1	2	3	4	5
not good				very good

What do you think of using E-mail in foreign language teaching (circle one)?

1	2	3	4	5
not useful				very useful

Are you going to use E-mail in your teaching (circle one)?

1	2	3	4	5
not at all				definitely yes

Please explain:

What do you think of using computers in foreign language teaching? (circle one)

1	2	3	4	5
not useful				very useful

What do you think of using digital technology in foreign language teaching? (circle one)

1	2	3	4	5
not useful				very useful

What do you think of using analog technology in foreign language teaching? (circle one)

1	2	3	4	5
not useful				very useful

What do you think of having another language technology workshop?

1	2	3	4	5
not necessary				definitely necessary

Suggestions for a coming workshop (use the page at the back if necessary):

Table 1
The Instructors' Attitude of Using Technologies before and after the Workshop

	Before the Workshop		After Workshop
	Average of all Respondents	Average of 7 Participants	
E-mail	4.0	4.0	4.3
Computers	4.5	4.5	4.3
Digital Technology	4.6	4.7	4.7
Analog Technology	4.1	3.8	4.1

Note:
Average of 7 participants = average of the participants who stayed at the workshop for the second week

Table 2
The Instructors' Self Assessment of Toolbook and E-mail Familiarity and Attitude of Using them at the End of the First Week and at the End of the Second Week

		At the End of the 1st Week		At the End of the 2nd Week
		Average of all Respondents	Average of 7 Participants	
Toolbook	Know	3.2	3.0	3.4
	Attitude	4.4	4.3	4.5
	Will use	4.5	4.4	5.0
E-mail	Know	2.8	2.7	3.9
	Attitude	3.8	3.9	4.3
	Will use	3.4	3.4	3.9

Note:
Average of 7 participants = average of the participants who stayed at the workshop for the second week

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Title:

Critical Analysis of Instructional Design

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INTRODUCTION

In undertaking the critical analysis of instructional design, we will frame our discussion within Habermas' three fundamental human interests, technical, practical and emancipatory. The primary goal of this paper is to explore alternative approaches for instructional designers' reflection and critique. Ultimately, this reflection and critique should shed light on how learning/instruction might be designed.

Instructional design, as an independent discipline, thrived when Skinner translated behavioral learning theory into programmed instruction in the 1960s (AECT, 1977; Glaser, 1982; Reiser, 1987). Since then, it has been aligned closely with learning psychology, and has been expanding its theoretical constructs by drawing upon communication and engineering theories (Eraut, 1985; Reiser, 1987; Richey, 1993). In the past three decades, its theoretical foundation became oriented toward different paradigms. Instead of looking at the comprehensive aspects of instructional design, we will focus on its major theoretical foundations.

Based on the theoretical analysis of instructional design, we will then summarize the general principles of the three interests. With a deductive approach, we will draw implications from these principles for designing instruction. In order to derive these implications, several dimensions of instructional design will be examined. They are knowledge construction process, and the roles of and relationships among resources, learners, teachers, instructional designers and even the client. In addition, the social, cultural and political context and environment of instructional design will also be discussed.

THEORETICAL ANALYSIS OF INSTRUCTIONAL DESIGN

Focus of design - toward prescription

The discipline of instructional design began at the period when programmed instruction incorporated systems thinking and communication theory in the 1960s. In the following years, instructional design gained more and more recognition in military and business training, especially when Gagne's theory was prevalently adopted by instructional designers. Since then, instructional designers have become more and more ambitious about, and confident of, their capability to make learning efficient and effective by matching instructional methods with learning objectives. Until the time when Gagne's (1985) cumulative learning theory was integrated with design theory, the theoretical foundation of instructional design, which is heavily dependent on learning psychology, was rarely challenged.

Although Bruner declared the need to differentiate descriptive learning theory from prescriptive instructional theory in the 1960s (Glaser, 1982; Clark, 1987), he has not constructed any theoretical guidance for instructional design. However, Reigeluth's (1983) conditions-methods-outcomes framework, which takes outcomes and conditions as givens and prescribes the best methods as variables of interest, exemplifies very clear guidelines for designing instruction at the micro-, mid- and macro-levels. He affirms that descriptive instructional theory with an if-then outcomes orientation can only passively predict what will happen by following certain instructional actions, whereas prescriptive instructional theory, with an in-order- to/ought-to methods orientation, is more rigorous in identifying optimal instruction. A prescriptive instructional theory with adaptable principles, in essence, is intended to provide practitioners, especially novice or incompetent practitioners, with better guidelines for making better instructional choices, judgements and decisions.

Landa (1983) reaffirms that theories and programs of instruction cannot be directly derived from theories and programs of learning because 1) learning theory does not tell anything about which of its propositions should be taken into account and combined in order to state an effective prescriptive instructional proposition, 2) the information provided by learning theories (both descriptive and prescriptive) and learning programs is necessary for building an instructional theory and instructional program, but not sufficient, and 3) in many psychological and pedagogical theories, regularities of learning are viewed as inherent and independent of instructional influences. Following Reigeluth and Landa, Heinich (1984), Winn (1986) and Clark (1987, 1989) also advocate the value of prescriptive instructional theory for designing instruction. Since then, prescriptive instructional theory has been regarded as a milestone which makes an extraordinary contribution to the theory base of instructional design.

What distinguishes prescriptive from descriptive instructional theory is the spirit of pragmatism, since the former focuses on the actions that could promote instructional efficiency, effectiveness and appeal. While emphasizing the need for prescriptive instructional theories, Reigeluth (1993) also recognizes the importance of learning theories to instructional design. He contends that many instructional designers, such as Gagne, Gropper and Scandura, create both learning theory and instructional theory. The link between the two has been strong. However, in order to provide novice or less competent teachers/instructional designers with help and guidance, prescriptive instructional theories will carry much more weight than descriptive instructional theories. They are tools to be applied, and especially to be adapted, to meet individual needs in different contexts. Such adaptation can be achieved through formative evaluation of a prescribed instructional model or theory. In other words, when a prescriptive theory is constructed, it is expected to be constantly tested and revised in reality.

Goal of design - influence from cognitive psychology

Even though prescriptive instructional theory has elevated instructional design to the state of a more independent field, its major theoretical foundation continues to be learning psychology, which is rapidly advancing. However, Bonner (1988) points out that cognitive psychologists do not necessarily find the link between, or synthesis of, learning and instructional theory satisfactory, despite instructional designers' interest in cognitive theory and their attempts to integrate it into their theory and research. She even indicates some conflicts between the principles of cognitive theory and the practice of instructional design. For example, instructional designers look for practical solutions to training people efficiently, which means quickly and at low cost, while cognitive psychologists are concerned primarily with the study of cognition and learning. Such disparity could be traced to the pragmatic emphasis of prescriptive instructional theory.

Winn (1989) laments that as long as instructional design separates design from delivery, it still operates at a behavioral mode, even though the behavioral objective and outcomes are changed to cognitive terms. He proposes that instructional designers should reflect more upon learning theory. Calls for closer linkage between learning theory and instructional theory are now being frequently voiced (Glaser, 1990; Tennyson, 1990; Hollis, 1991)! After years of effort in establishing instructional design theories and in applying them to training, instructional designers are finding out that their practice is lagging behind the advancement of the sources upon which they once drew. Although Reigeluth (1989) calls for enriching the knowledge base of instructional design, many of the instructional design theories have not yet been revised to incorporate the new findings of cognitive learning theories.

Unlike the 1970s, when instructional theorists successfully used the principles of behavioral learning theories to generate instructional theories, they now have increased difficulties in using advances in cognitive learning theory to generate related instructional principles. One of the major reasons might be that the community of instructional theorists has been endeavoring to apply theories rather than developing theories and consolidating the knowledge base. Efforts expended in constructing instructional theories based on cognitive psychology, such as those to teach higher order thinking, are still inadequate. The theoretical foundation of instructional design is questioned again when constructivism attracts the attention of instructional designers.

Design for constructive learning

While instructional designers are still facing the challenge from cognitivist theorists, constructivism proponents have arrived on the scene. Notably, when the three cognitive psychologists, Collins, Brown and Newman (1989) proposed the cognitive apprenticeship instructional model, some instructional designers started instilling the spirit of this model into their design of instructional materials (Duffy & Jonassen, 1991; Duffy, Lowcky, & Jonassen, 1992). Some instructional theorists are not content to see the distinct line drawn between descriptive and prescriptive theory (Bednar, Cunningham, Duffy and Perry, 1991; Duffy and Jonassan, 1991) and contend that instructional designers should design in context, not in procedures for teachers to follow.

The questions posed by cognitivist theorists and constructivism proponents are quite similar. They both embrace a closer link between learning theory and instructional theory. Since learning theory has evolved from behaviorism to cognitivism to constructivism and even to cultural psychology (Bruner, 1990), instructional theorists undoubtedly will have to struggle with such evolution while constructing their own theoretical foundations if they hope to maintain instructional design as an independent discipline.

Challenges from prescriptive instruction, cognitive psychology and constructivism to the theoretical foundation of instructional design certainly contribute to its evolution. However, looking into the nature of these challenges closely, we can find that many of the arguments about what an instructional theory should be centers on two questions. First, what are the sources upon which an instructional theory can draw? Should instructional principles be derived completely from learning psychology? The second question is, will a prescriptive approach to designing instruction violate the way people learn? We regard the two as separate questions that need to be dealt with independently. By doing so, we can then synthesize the new advancement of learning theories and include other design possibilities with the knowledge base of current instructional design.

New lens for design - critical theories

Unlike the local challenges from the proponents of learning psychology, critical theories seem to provide some alternatives for instructional designers to reflect upon the possible ways for improvement from a more global view. In Paradigms Regained (Hlynka and Belland, 1991), a variety of critical perspectives is introduced to the field of educational technology: Habermas' critical theory, criticism and connoisseurship, semiotics, postmodernism and deconstructivism, and curriculum criticism. Among these diverse critical perspectives, Habermas' theory has been most deliberately applied to the study of instructional design, especially by Streibel.

Habermas (1972) identifies three basic cognitive interests: technical, practical and emancipatory. These interests constitute the three types of science by which knowledge is generated and organized in our society. Grundy (1987) presents a very good interpretation of these three human interests. She contends that technical interest, according to Habermas, is an empirical/analytical way of knowing, with an aim at control and prediction through implementing pre-existing ideas. When we apply it to instruction and learning, we will find that effectiveness and efficiency are the goals for such interest. According to Habermas,

> the type of knowledge generated by empirical-analytic science is grounded in experience and observation, often produced through experimentation. There is a relationship between knowledge and power and between science and technology. Habermas is making a stronger claim that there is a possible relationship between prediction and control. For Habermas the fundamental interest which guides empirical-analytic science is an interest in control and the technical exploitability of knowledge. .... The technical interest is a fundamental interest in controlling the environment through rule-following action based upon empirically grounded laws (cited in Grundy, p. 10-12).

Practical interest, in Grundy's words, means historical and hermeneutic ways of knowing in which meaning is socially and culturally constructed in the speech acts and practices of interacting human agents. The emphasis here is the meaning-making process rather than the end product of instruction and learning. Grundy (1987) further contends that practical interest is an interest in taking the right practical action within a particular environment and is oriented toward the moral sphere. This is, indeed, consonant with the development of cognitive learning psychology.

As to a critical way of knowing, Grundy maintains that the emphasis is on critical reflection upon social and cultural practices. People become conscious of the pre-understandings in existing social and cultural practices, uncover the contradictions between the ideal of truth, justice, and freedom and actual social and cultural practices, and change social practices. Habermas maintains that

> Although interests are fundamental orientations of the human species, they can themselves be categorized either as being stimulated by inclination or by principles of reason. .... It is important to realize that interests can also be stimulated by principles of reason. ...... Habermas views persons as intrinsically, or at least potentially, rational beings, so interests which are stimulated by reason are more fundamental than interests which are stimulated by inclination or desire (cited in Grundy, p.17).

Grundy interprets Habermas' fundamental "pure" interest as being grounded in reason, an interest in emancipation. She regards Habermas' emancipation as "independence from all that is outside of the individual and is a state of autonomy and responsibility. More importantly, it is only in the act of self-reflection that emancipation is possible" (p.16).

Streibel (1991) has applied the first two ways of knowing to examining the practice of instructional design, maintaining that the technical human interest approach to theory and practice treats theory as a guide to action. Traditional instructional design falls into this category. If instruction is conceptualized as a set of cultural practices, a social construction and meaning-making process, it operates at the practical interest approach. He further states that instructional designers should find ways to design resources rather than plans for teachers and learners if design is regarded as process rather than product. In his words, "instructional theories should be treated as resources, rather than plans", because "all human practice is situated in an ongoing context that requires continual judgement" (Streibel, 1991, p.851). As a matter of fact, this argument is similar to Winn's belief that the integrity of instruction lies in the fusion of instructional design and implementation during the real time of teaching. From the various perspectives of cognitivist theory, constructivism, and critical theory, it is apparent that why instructional theory should serve as prescriptive guidance for practitioners, either novice instructional designers or classroom teachers, has been a topic for argument in the past decade. Are prescriptive instructional theorists and those who object to the process of prescription really focusing on the same thing, or are they indeed talking about two different issues? When instructional designers incorporate constructivism into their design of classroom lessons or multimedia learning environments, are they following any prescriptions or principles to initiate their design task? Even when designers are designing resources as Streibel recommends, do they not need some guidance on how to design the kind of resources that could enhance the meaning-making process?

It seems that there are two different dimensions of questions intertwined here. What are the educational/training goals that orient instruction or instructional design? What kind of sources do instructional designers draw upon to design instruction? Without keeping these questions clearly in mind and dealing with them independently, the search for a better framework for designing instruction might be futile. Since Habermas' critical theory encompasses all three ways of knowledge construction, we regard it as a valuable source to expand the research and practice of instructional design.

From the above theoretical analysis of instructional design, it is revealing that the development of instructional design has undergone several major theoretical advances. The dimensions of instructional design are broadened every few years, and arguments about the theoretical foundations for design have never ceased. Rather than looking at the evolution from behaviorism to cognitivism to constructivism as a replacement process and viewing these various paradigms as incompatible, we view Habermas' critical theory as a potential source for expanding our vision of instructional design.

ANALYZING INSTRUCTIONAL DESIGN FROM HABERMAS' THEORY OF KNOWLEDGE

In the previous section, it has been indicated that Habermas' theory of knowledge has three forms, or processes, of inquiry: knowledge that is arrived at through empirical-analytic science, historical-hermeneutical science, and critical science. Each of the three requires a different methodology for knowledge construction. According to Koetting and Januszewski (1991), among the three ways of deriving knowledge, critical science aims at deriving analyses that free consciousness from its dependence on hypostatized powers. The task of analyzing instructional design critically is, therefore, targeted at enlightening people's many misconceptions of what instructional design should be. In order to draw implications of Habermas' framework of human interest on the research and practice of instructional design, we have organized his framework into a two-dimensional scheme by which the various aspects of his theory and its corresponding implications for instructional design could be clearly presented. Table 1 summarizes the various characteristics of each interest.

Implications for Instructional Design

The implications Habermas' theory has on instructional design also have been organized around several themes: (1) knowledge construction process of instructional design, (2) the relationship between theory and practice, and that among learners, teachers, designers and clients. Since this section focuses on generating implications for instructional design, a corresponding table (Table 2) of instructional design with the three interests is presented after Habermas' scheme for better comparison.

Table 1: Dimensions of Habermas' Three Fundamental Human Interests

	Technical	Practical	Emancipatory
1. Basic Orientation	controlling & managing self,other& environment	understanding self,other,& environment	empowering those involved in the environment
2. Focus	product	process	praxis
Goal	explaining, predicting	meaning-making	justice, equality
Outcomes	correct behavior	rational/ moral action	responsible, autonomous action
3. Knowledge Representation	facts, laws, procedures	narrative stories	critical theorems
Knowledge Required	skills	judgement	critique
Knowledge Grounded in	experience & observation	understanding of meaning	critical insights
Knowledge Application& Construction	following rules	making judgement	reflecting upon distorted/taken for-granted views
4. Authority Resides in	plan	practitioner	historical community
5. Role of Theory	theories guiding actions	theories treated as resources for actions	theorems helping construct new knowledge

(Adapted from Streibel, 1991)

Table 2: Instructional Design with the Three Interests

	Technical	Practical	Emancipatory
1. Basic Orientation	controlling & managingthe environment	understanding complexity environment	empowering in a learning environment
2. Focus	instructional product for T's (L's) use	interaction process of t/l	praxis
Goal	prespecify certain learning outcomes	making the learning & teaching process meaningful	restructuring environments that prohibit justice and equality of t/l
Outcomes	correct, prespecified learning outcome	rational/ moral t/l actions	responsible, autonomou learning & instruction
3. Knowledge Represen-tation	facts, laws, procedures	narrative stories	critical theorems
Knowledge Required	skills	judgement	critique
Knowledge Grounded in	experience & observation of t/l	understanding of meaning	critical insights into t/l
Knowledge Application& Construction	teachers following instructional rules	teachers (L) making judgement on own t/l	teachers (L) reflecting upon distorted/taken for-granted views
4. Authority resides in	instructional plans	teachers	teachers' community
5. Role of Theory	instructional theories guiding t/l actions	instructional theories treated as resources for actions	instructional theorems helping T/L construct

Notions of Knowledge

Technical interest: Since designing with the technical interest focuses on attaining prespecified outcomes and intends to derive a certain product, the teaching and learning activities are often planned along with those outcomes. In order to plan these activities in advance, some theories or principles are required for the designers to follow. Such theories or principles are often generated by experiences, or observation and synthesis of a number of teaching and learning phenomena. The result of such design tends to be a prescribed set of instructional methods for teachers' application. These prescribed methods may serve as a lubricant to the completion of a complicated design task at best, and sacrifice the flexibility of design at worst. Hence, these methods have to depend on an early stage of formative evaluation in order not to sacrifice the flexibility and dynamism of learning and instruction.

If a prescriptive theory is intended to be applied by practitioners, it has to be constructed with sensitivity to the ongoing process of teaching/learning, and be embedded with formative research in the generation of theory. That is, formative research should be an integral part of a prescriptive theory (Reigeluth, 1993), and a prescriptive theory can be viewed simply as a blueprint or prototype for another better prescriptive theory, which will not be completed until it incorporates the needs of users within a specific context. While the needs and characteristics of users and the conditions of a context or environment are assessed before instruction, it is also important to continuously diagnose the emergent needs in the course of real teaching-learning interaction.

Practical interest: Therefore, when a prescriptive theory is formed in such a manner, it has more a spirit of the practical interest than of the technical interest. However, the outcomes and conditions of instruction have to be defined and redefined during interaction, not simply interpreted beforehand. Otherwise, it will still be designing with the technical spirit disguised by a practical facade.

As a result, such a move toward the practical interest will encourage practitioners to make their own judgements on what is appropriate for themselves. An instructional theory or a set of principles is hence regarded as a resource for the teachers to adapt and modify their instruction based on their judgement. Designers along with teachers in this circumstance will use their understanding of the processes of teaching and learning to construct their knowledge about learning and instruction, which will better improve their conception and practice of design. What can best capture such a process might be narrative stories that present the richness of the meaning-making process of teaching and learning, since they can inspire the practitioners to make their own judgements.

Emancipatory interest: The emancipatory interest to designing instruction sees the beliefs and ideologies that designers hold as a potential impediment against the empowerment of those involved. Designers who espouse the emancipatory interest hence look into the ideologies dominating themselves and others, and examine how these might prohibit them from carrying out their understanding into actions. When design is penetrated by the ideologies which are identified as viable and applicable without taking into account whose interests are served, genuine justice and equality will not be obtained. Indeed, the extent to which certain ideologies are recognized and accepted often determines the degree to which the existing power relationship and existing interests will be maintained. But how could designers capture their own distorted beliefs and values, and in the meantime, empower those involved to look into theirs in order not to be confined within those social and cultural constraints?

According to Grundy (1987), "one of the fundamental ways in which ideological oppression operates is to make that which is cultural (and hence in principle susceptible to change) appear natural (and hence unchangeable)" (p.104). However, since ideologies, as Grundy contends, are the dominant ideas and thinking of a group or culture, it is often overlooked that our common-sense understandings of reality may involve some unrecognized forms of domination. Emancipation from the predominant ideologies may not be possible simply through processes of reflection, such as those which characterize the practical interest. Emancipation should be built upon continuous reflection upon these beliefs and ideologies.

It is not until design is aimed toward uncovering underlying beliefs and values that we can better rise up from the confinement of ideological oppression. Therefore, the emancipatory design approach constructs knowledge through continuous problematization: "recognizing the problematic nature of existence is [becomes] essential in order to address questions about the root causes of problematic aspects of life and address possibilities of change" (Grundy, 1987, p.104). The design efforts of the emancipatory interest are not expended on constructing instructional methods for teachers to apply nor on merely encouraging practitioners' judgements about their own teaching and learning. Rather, they will aim at liberating the practitioners from the confinement of any social or cultural taken-for-granted views, focusing on what could be reconstructed, and enabling them to take responsible and autonomous actions.

Since the knowledge construction process of emancipatory design is engaged by not only designers but also teachers and learners, designers could better reflect upon the distorted beliefs through critical theorems.
Grundy explains that

> a critical theorem is a theoretical reconstruction of the undistorted human competencies through which the human species has constituted itself; it is a theory about fundamental human capacities, undistorted by the operation of ideology, which have been the basis for the species' evolution. These critical theorems are implicit in the very nature of human interaction and thus represent a potential for enlightenment and emancipation (1987, pp.111-112).

These critical theorems are also used to assist the teachers and learners to penetrate their own confined views, and reconstruct new knowledge for learning and teaching. Nevertheless, the creation of critical theorems is not the ultimate goal of design for those who hold the emancipatory interest. Following this would be the organization of processes of enlightenment and the conduct of the political struggle, both of which were suggested by Habermas. But how can the designer help teachers and learners become enlightened on the problematic aspects of their learning and teaching?

Design Incorporates Processes of Enlightenment

The design knowledge that is constructed in the emancipatory mode has to be authentic from the teachers' and learners' perspectives, not the designers', since it is they who make sense of whether it is authentic or not. Such authentic knowledge involves practitioners in authentic experiences through critical self-reflection upon personal practice. McTaggart and Singh (1986) claim that

> "critical reflection involves more than knowledge of one's values and understanding of one's practice. It involves a dialectical criticism of one's own values in a social and historical context in which the values of others are also crucial. Criticism itself is, therefore, a relational concept; criticism can only be conducted in a community where there is determination to learn rationally from each other" (p.43).

Since authentic knowledge goes hand in hand with critical self-reflection, the two will orient the teacher and learner toward the processes of enlightenment of their own problems. The constraints that are culturally shaped (and hence are susceptible to change) will be the targets for critical reflection in the design process. Designers, who focus on distinguishing natural from cultural constraints, will hence engage themselves and all others in examining the problematic aspects of cultural constrains. The destiny design leads to is the uncovering of factors that prohibit and prevent the autonomous actions of learning, instruction and design respectively. That is to say, the enlightenment processes are more concerned with the clarification of root problems of learning, teaching and design than with what is to be and how it should be learned, taught and designed. It is a fundamental approach to enabling practitioners to analyze and diagnose their own learning/teaching problems, and to reflect upon why they teach or learn the way they do and what they might reconstruct.

In many cases, instructional designers do emphasize to a large extent the identification of problems. However, such problem identification is often confined within certain parameters. It is within the boundary of such parameters that designers can not free themselves from the historical or social constraints on their practice. There are some cases in which instructional designers do capture the structural tyranny, and realize that fundamental change has to be enacted from the organizational or institutional level. But even so, it is very rare that teachers or learners are involved altogether in examining how their beliefs and values have been shaped by institutions, and how the institutions in turn have shaped their way of thinking, believing and acting. Therefore, even when instructional designers attempt to identify, analyze and solve problems, it does not necessarily mean they are engaging in critical awareness of their environmental and cultural constraints.

Cosgrove (1982) contends that meaningful learning cannot be separated from autonomous learning. In order to make learning experiences themselves meaningful, the conditions under which learning occurs must be fundamentally changed. This idea has profound implications for design. It is important that instructional designers should not be satisfied with merely identifying the existing conditions and constraints, but they should take a further step to reconstruct the constraints, and to provide conditions under which learning will best occur. To put it differently, designers must improve their understanding of teaching/learning theories; they must also understand the context of learning/teaching, being ready to challenge that context if it prohibits the teacher and learners from becoming autonomous. Designers should also continuously remind themselves that, while acting collaboratively, they may not engage in reflective action at all; the two are not equivalent. To adopt the emancipatory approach to design, any design action must be reflectively generated. The purpose of taking responsible and autonomous actions is to transcend the barriers to such reflection. In one sentence, the enlightenment process, as a major characteristic of emancipatory design, is a continuous problematizing process.

Relationship between Theory and Practice

Based on the above clarifications, we could draw a conclusion that the various approaches to design imply different relationships between theory and practice.

Technical interest: An instructional theory embodying the technical interest is applied as if it were a natural science. "It is assumed in order to guide practice and to test a sounding theory" (Streibel, 1991, p.860). Such design efforts lean toward the side of theory, which is regarded as a higher-level of knowledge. It is revealing that much of the practice of instructional design falls into this category. In many cases, skills acquisition, rather than the process of learning and teaching, has been regarded as the top priority. Many instructional models also focus on the specification of types of knowledge, and optimal ways for teaching. Gagne's conditions of learning and nine events of teaching is a good example of designing learning and instruction with the technical interest in mind. If an instructional designer simply follows his theory to approach a design task, even though he might accomplish an efficient task, he is simply practicing design technically.

Practical Interest: However, meaning is socially and culturally constructed through human interaction, as claimed in the beginning of this section. The practical interest is a fundamental interest in understanding the environment through interaction based on a consensual interpretation of meaning. Therefore, a theory in the practical interest, from Grundy's view, is "judged according to whether the interpreted meaning assists the process of making judgements about how to act rationally and morally in the world" (p.14). With such an orientation of design, theory and practice inform each other, and more important, theory is constructed through the meaning-making processes engaged most of the time by learners and teachers, unless designers themselves play participant observers at a deep and persistent level.

Emancipatory interest: An instructional theory with the emancipatory interest will manifest the ideas of truth, justice and freedom, which are regarded as "transcendental realities within everyday human interaction rather than within some external reality" (Habermas, 1972, cited in Streibel, 1991, p.858). Since emancipation is a potential waiting to be realized in the world of every human being, designers have to first become critically conscious and aware of how they construct their current knowledge in order to realize emancipation. They also need to socially reconstruct their knowledge, beliefs and practices, critically reflect on social and cultural practices, and finally restructure their future actions. The relationship between an instructional theory and practice within emancipatory design, therefore, contains political elements through which teachers' and learners' autonomy and responsibility can be promoted through collective and reflective efforts. The political struggle here lies in the fact that the theory focuses on consciousness of the pre-understandings in existing social and cultural practices. The struggle also attempts to reveal the contradictions between the ideals of truth, justice and freedom, and actual social and cultural practices.

More important, the theory does not simply guide teachers' and learners' action; neither does it assist their judgement-making on their own practice. Rather, it helps designer, teachers and students struggle to change their social, economic and cultural conditions. Such an approach to design will ultimately lead to restructuring the whole learning and teaching system, and the efforts that more and more instructional theorists are making in redesigning the educational system make this possibility viable. The emancipatory design obviously takes into account more fundamental issues about learning and teaching.

Implications on the Relationships between Designers, Teachers, Learners and Clients

The relationship between theory and practice also underlies the power relationships between designers, learners, teachers and clients embedded in the design process. Designers should recognize that the traditions of the division of responsibility and the distribution of power in the work of design are strongly embedded in the histories of designers, their clients, teachers and learners. To examine the existing power relationships in a design task, designers need to locate themselves inside the community of instructional designers, teachers, learners and any other groups which are involved. This is Habermas' (1972) belief that the authority of the emancipatory interest resides in the historical community, not simply a particular group regarded in isolation from its tradition; the social, cultural and historical factors are the essence of such a community. After positioning themselves within the realm of such a historical community, designers will be able to see more clearly how their beliefs and values are shaped; by doing so designers can then transcend the limitations of their current practice and broaden their visions to other design possibilities.

Especially for those who endeavor to restructure the educational system to foster learners' independent and autonomous learning, the recognition of historical community is important. Therefore, within the emancipatory design framework, the designer is no longer the one who designs instruction but the one who is educated in the learning/ teaching processes. The learners and teachers, in turn, while being the targets for liberation, also liberate designers by presenting designers with new insights into their design practice. In addition, the teacher, as stated by Freire (1972), is "no longer the-one-who-teaches, but one who in himself taught in dialogue with the students, who in their turn, while being taught, also teach" (p.53). Freire does not mean that the teacher no longer has any role in the selection of knowledge for study, for the character of liberating education is dialogical not monological. This means that [the designer, teacher and students] all have the right and responsibility for contributing to the process of [learning, teaching and design] (Freire, 1972, p.92).

The instructional designer must assume a new role within this emancipatory framework. When design efforts are oriented toward the emancipatory interest, an instructional consultant rather than an instructional designer will be more appropriate for the task. Using Habermas' (1972) analogy, the instructional consultant will act like a psychoanalyst, whose dialogue with his/her client focuses on self-enlightenment and problem-solving. It can be said that the instructional consultant will not only think and act in a dialogical and reflected mode, but also negotiate with any party line which may prohibit the reconstruction of cultural and social constraints on the processes of learning and teaching. The ethical and moral responsibility is a new dimension for consideration. Similar to those who engage in educational systems redesign, efforts are expected to be expended on overcoming the political, social, cultural and environmental barriers embedded within the system.

From the above description, it is obvious that much practice of instructional design still embodies many characteristics of a technical nature. Many people have now started to design their instruction by focusing on the resources or learning environment, which can provide learners with a greater space for navigating and inquiring. Applying constructivism and situated learning to instructional design is no longer a dream. Vanderbilt group's anchored instruction and Duffy and Jonassan's (1993) design of a constructivist learning environment both demonstrate such a possibility. Another example is Tripp and Bichelmeyer's (1991) rapid prototype, in which learning/instructional goals and methods are selected based on the continuous interaction among the designer, teacher, learners and the client. However, while there are more and more design issues brought up to accommodate the practical interest, interest in the emancipatory design has not yet been widespread. Moreover, these design models or approaches embody elements of more than one interest. Our contention is that Habermas' three knowledge interests are not supposed to dominate our thinking and action in a clear-cut manner. Although one particular interest may dominate our decision-making process and actions, we do not have to be restricted to it if the other two have value.

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ASSUMPTIONS FOR APPLYING THE THREE KNOWLEDGE INTERESTS TO DESIGN

How Do the Various Interests Orient Our Actions?

The first question we need to ask is, do Habermas' three knowledge interests always operate in insolation or interact to some extent within our cognition and action? Although it appears that each of the three fundamental human interests has a distinct set of characteristics, we need to inquire, in reality, whether our cognition and actions fit neatly into simply one interest or another.

Living in this postmodern society, pluralism and multiplicity have received great attention and are widely discussed in education. People always have different intentions, expectations and attitudes when approaching a task. Even for the same person, he/she might have various intentions and expectations of, and attitudes toward, various tasks, at different stages of his/her life. Although Habermas (1972) argues that the emancipatory interest is the highest form of human rationality, it is not, in fact, the only interest dominating every action we take. Our lives are multi-dimensional, and hence at different times and in different situations we often take different actions.

Design tasks are human activities complicated by many social, cultural, and even political and economic interplays. A design task often involves various domains of problems to be solved, which requires different types of knowledge and actions. We may have an ultimate goal guiding our action, but in order to achieve that goal, we might need to undertake various kinds of efforts. Design is usually conducted and carried out through diverse considerations; a designer often needs to negotiate among different stakeholders. Toward which of the three interests a design task is oriented is thus influenced by these considerations.

What Are the Relationships among the Three Interests?

When looking into the relationship among the three interests, Grundy (1987) maintains that while the practical interest is compatible with the emancipatory interest, the technical interest is not. Does this mean that the practical and emancipatory interests might orient one's cognition and action simultaneously, but not the emancipatory and the technical? Or could the technical interest operate at a different level from the practical and the emancipatory? If only two of them can coexist, does it preclude the application of the third one?

Theoretically, the three interests are different from one another in many domains. But realistically, each of the interests exerts different degrees of influence on people's thinking and action when they engage in a task. After all, is the technical interest a preparation for, or inhibition of, the practical interest? Will the practical interest naturally lead to the emancipatory interest because of their compatibility? Do people only need to adopt one interest to solve different problems? Or do the three interests indeed operate at various levels?

Is Any of the Three Interests Worse than Another?

In answering the above questions, we have to ask a relevant question: Is any one of the three interests inherently worse than another when it dominates the practice of instructional design? Or is emancipatory design always the best? If we think the practical interest is better than the technical, then we should direct our efforts toward the practical mode of thinking and action. Similarly, if we agree that the emancipatory interest is the highest form of human rationality, as justified by Habermas (1972), and believe that it should always direct our actions, then we certainly should eliminate any possible actions that serve either the technical or practical interest. Habermas seems to value the emancipatory interest more than the other two when maintaining that it has the purest rationality. However, when we apply it to the analysis of instructional design, does it mean we should completely abandon the kind of design practice that is dominated by the technical or practical interests?

The Significance of Taking into Account All Three Interests

The significance of taking all three interests into account while engaging in a design task is that we need more alternatives to broaden our vision of design, and expand our considerations about design in the complex human arena. If we limit ourselves to only one single interest, we will lose sight of other possibilities. The critical point is our ability to determine which mode of actions to take when coping with a certain problem. It is also essential to identify the conducive situations for each of the three interests to play. More important, the kind of efforts required by each interest should be recognized.

In the evolution of any discipline, we could find that new ways of thinking and doing always gain popularity when they are more accountable to some phenomena than the old ones. Nevertheless, even though our knowledge keeps advancing, there remain some aspects of human activities which could still be better done in the old ways. While we should not let the old paradigms of thinking prevent our progress, we may not make a wise decision when trying to replace everything with a new paradigm. The purpose of looking at the values, weaknesses and strengths of each of the three interests in determining designing efforts is to incorporate as many design possibilities as is useful. We need to have a larger repertoire to accommodate the needs of a wider range of contexts. Moreover, the routes to the highest goal are many; we need to identify as many of them as possible, rather than choosing only one route.

NEW PERSPECTIVES ON INSTRUCTIONAL DESIGN

In the previous sections, we have provided critical perspectives on the practice and research of instructional design. We first have summarized the various dimensions of Habermas' three fundamental human interests into a table so as to draw implications for instructional design. However, we have only focused on the notions of knowledge, the relationship between theory and practice and the relationships between designers, teachers and clients. The main purpose of such a critical analysis has been to inquire how the three interests might be applied to the design of learning and instruction, and why it is essential to take all three interests into account. More important, the analysis serves to generate a set of new perspectives for instructional design.

Oneness of Learning, Instruction and Design

Traditionally, learning theories, instructional theories and instructional design theories are treated as three distinct entities. While the numerous arguments about whether instructional theories can stand alone from learning theories are made, recent exploration of cognitive psychology provides a great deal of insights into the possibilities of integrating the two. However, beyond the integration of learning and instruction there is a certain point where learning, teaching and design can come together. That is when learners, instructors, and designers engage all together in reflective and critical thinking to explore the fundamental problems from diverse perspectives. It is our belief that instructional designers or teachers should be particularly reflective and critical in thinking and dialectic in interacting, and respect a world of plurality instead of certainty and control, so that a journey of instructional design will be redirected to unlimited possibilities.

Transactional Roles of Learners, Teachers and Designers

Instructional designers who have taken for granted that their knowledge of instruction exceeds that of many teachers need to reflect on the complex interactions between learning and instruction. Learners should be given the responsibility to direct and manage their own learning. When they become self-teachers, they will be more creative. In addition, teachers' ongoing self-awareness and self-reflection will enable them to perceive instruction in a dynamic way; teachers' and learners' reflection will allow them to make decisions about the kinds of instruction and learning appropriate for learners. The mission of instructional designers is to enable teachers to reflectively design instruction that can empower students to design learning for themselves.

In a learning-centered environment, instructional designers will be the backstage heroes, assisting learners and teachers to become the main actors of the learning drama rather than controlling the learning environment. All learners, teachers and designers should engage in the process of learning and deepen their understanding of the purpose of teaching and design. Knowledge about learning theories or instructional theories, or even design theories is not the privilege of any one of these groups, although the extent to which they need to know these varies from one group to another. Designers should not limit themselves to the task of design. With a deep understanding of the complexity of teaching and learning, and insights into human nature and potential, designers will no longer confine themselves within a certain paradigm or approach, but continuously explore new possibilities. In summary, the new role of the instructional designer is transactional with that of learners, teachers and client in both the local and general contexts.

New Perceptions of Designers

Instructional designers need to recognize the uncertainty in any design context, since reality is constantly changing. A mindset that can accommodate such uncertainty must be cultivated. They should have the ability to grasp the wholeness and originality of the phenomena they observe without projecting their own personal biases. By doing so, they can see and detect the hindrances in learning and teaching, and hence find an appropriate way to loosen them. They also should make keen observation of the learning context so that they can adapt their design whenever it is necessary. Their readiness for adapting design approaches is very important. With these capabilities, instructional designers can play several different roles.

The roles an instructional designer can play are many. In the critical analysis section, we have pointed out that when an instructional designer practices the emancipatory approach, he/she is no longer an instructional designer but a consultant who is concerned with more than the content of learning and teaching. The consultant is like the psychoanalyst who helps his/her clients to discover their own problems and assumes responsibility to solve them. He/she will focus on ways of enlightening teachers/clients.

Indeed, if an instructional consultant has a philosopher's curiosity about what life really is, a psychologist's insights into human emotions and personalities, and a sociologist's concern with the complex relationships entangled in our reality, he/she will expand his/her own repertoire for design. Designers need to learn to think like historians, anthropologists, inventors, and even artists. This does not mean designers have to master the knowledge of every discipline. What is proposed here is a new perception and expectation of, and new attitude toward, what we have being calling "instructional designers".

As argued earlier, skills for design are important, but critical insights are what advance the discipline of instructional design. Designers should not only focus their attention on the processes of learning and teaching, but on the social, political and economic impact on these processes. Even the most advocated view among instructional designers, a systemic approach to design, requires designers to continuously reexamine their relationships with others who are also involved in learning and teaching. Within the larger system, the instructional consultant should not only think and act in a dialogical and reflective mode, but also negotiate with any party line which may prohibit the reconstruction of cultural and social constraints on the processes of learning and teaching. This ethical and moral responsibility presents a new dimension for consideration, and efforts should be made to overcome the political, social, cultural and environmental barriers embedded within the system.

Direct Pointing to the Problems: from Problem-Solving Design to Enabling Design

When an instructional consultant assumes more social responsibilities, the ultimate goal of instructional consultation is no longer solving some particular teaching or learning problems. It is to enable learners or teachers to diagnose problems for themselves, and search for solutions to these problems. More fundamentally, the consulting process is a continuous and ongoing problematizing process. The root causes of the problems are traced not only to actions, but also to one's ideology and beliefs. The purpose is to uncover factors that prohibit and prevent the autonomous actions of learning, instruction and design, respectively. It is a fundamental approach to enabling practitioners to analyze and diagnose their own learning/teaching problems, and to reflect upon why they teach or learn the way they do and what they might reconstruct.

Much of the current emphasis on problem analysis in the process of design still operates at a superficial level. It is often confined within certain parameters, within which designers could not free themselves from the historical or social constraints on their practice. Especially when politics is involved, proposed solutions to the problems often end up conforming to those who have the power to make decisions. Therefore, the move from a problem-solving design to an enabling or empowering design requires us to look into the depths of a problem in order to find the fundamental causes prohibiting one's ability to undertake the problem independently. Such a role for the instructional consultant will demand more discipline.

Travel Across the Boundaries

An instructional consultant should be able to travel across the boundaries of the three approaches to design. The three approaches suggested in this study could provide us with more design or consultation considerations. While we should not resist the guidance of theories or principles, we should always look into the limitations of each of the approaches. Some of their limitations may be inherent, embedded in the underlying assumptions of the approach. However, many more limitations are imposed by those who undertake them if they are not able to flexibly apply these approaches, or elevate themselves beyond the boundary of a particular approach.

But to be able to freely and creatively use the three approaches, an instructional consultant would regard skills or methods as merely stepping stones for learning and teaching. Skills which are identified as good and useful will be changed, and even discarded at certain points in time, so that new skills can be constructed. The purpose is not to demean skills, but to point out the limitations of them, since too much emphasis on skills tends to prevent learners and teachers from searching for other possibilities. Learning can be constructed, deconstructed and reconstructed again. There are no fixed rules for learning or teaching. Without such an understanding, it will be approached always within the skill paradigm.

Instructional design, in the new light through Habermas' knowledge framework, demands the cultivation of visions and perspectives, and requires humanistic concerns and more discipline. In addition to familiarity with the three design approaches (technical, practical and emancipatory), practitioners who wish to design practically and critically have to possess the capability to grasp the situational and dynamic nature of learning and teaching. Those who have practiced design for a long time may not necessarily be better than the novice in applying design if they are confined within their long-held design beliefs, resisting new possibilities and new visions of design. They should also learn to see a design task holistically and situationally, without segregating learners from teachers and designers, or even the process of learning from teaching and design. Considerations of design are based on broader and deeper foundations. Methods of learning, teaching and design are simply tools to reach the ultimate goal; they are means, not ends, of design efforts. Therefore, design should not end with the construction of methods for application. In the process of instructional design, designers should committ themselves to transforming reality when necessary, not simply to designing a learning/teaching task. However, we should recognize that methods are vitalized by those who use them, not the other way around. Methods themselves have no life; it is the person who knows when and how to use which methods so as to make a certain approach more appealing than others.

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Title:

Modeling vs. Coaching of Argumentation in a Case-Based Learning Environment

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Introduction

In recent years, the development of computer based learning environments has been influenced by the development of more powerful computer technologies and theoretical orientations . On the technology side, we have more and more powerful systems which are capable of delivering sophisticated multimedia (computer graphics, animation, audio and video) on the desktop. These systems afford instructional designers the capability to present a information, real problem situations, and real life experiences (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990). On the theory side, we have more situated models of meaning making. Contemporary approaches to instructional design are more concerned with students' abilities to use the knowledge they acquire to solve real life problems. Bransford and associates (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; CTGV, 1990) note that in conventional teaching and learning, the students often fail to understand the value of new information for problem solving, because they do not experience the kind of problems that help them realize how information can be used to solve meaningful problems. Therefore, students too often treat new knowledge as something to be memorized which results in the acquisition of inert knowledge. Students often exhibit oversimplifications and compartmentalization (Spiro, Feltovich, Jacobson, & Coulson, 1992). Brown, Collins and Duguid (1989) also argue that in classroom teaching, teachers attempt to teach salient features to the students and dismiss the contextual and peripheral features of authentic tasks as "noise." This decontextualization does not enable learners to solve real life problems. "By ignoring the situated nature of cognition, education defeats its own goal of providing usable, robust knowledge."

A number of models for designing constructivist learning environments have been proposed. Most of them are case-based and try to present context-rich, information-rich and situated learning environments that are relevant to learners (Duffy & Jonassen, 1992.) A prime example of case-based learning is provided by anchored instruction (CTGV, 1992; CTGV, 1990; CTGV, 1993), which provides an authentic and generative learning environment in which students generate and combine sub-goals to meet the challenges afforded by the case. Students learn to use mathematics in solving the problems, rather than merely memorizing formulas. Very rich contextual information helps the project achieve this goal.

Brown, Collins and Duguid (1989) argue that learning is indexed by the experience and activities in which the learning happens. They argue that learning should be situated in authentic activities. For students to use tools in a way that they are used in real life, students must "enter the community and its culture," just like a craft apprentice learning skills from a master. They proposed a model of cognitive apprenticeship, which takes into account the situated nature of leaning. In cognitive apprenticeships, the emphasis is placed on teaching student to learn how experts solve problems and carry out tasks. Cognitive apprenticeship is a process of "learning-through-experience." (Collins, Brown, & Newman, 1989). Making coherent arguments has been identified as one important outcome of instruction in constructivist learning environments, because it reflects learners' understanding and internal organization of knowledge. Most constructivist approaches to learning, such as cognitive apprenticeships, emphasize a different set of instructional strategies including modeling, coaching, scaffolding, articulation, reflection, and exploration.

Modeling and Coaching of Performance

Of particular interest to this study are two support strategies, namely cognitive modeling and coaching. Bandura (1977) notes that by providing subjects with modeling, performance guidance, corrective feedback and self-directed mastery, we can foster learners' skill development and self-efficacy. With cognitive modeling, the teacher can expose learners to the expert's covert cognitive processes in problem solving. Usually the teacher will verbalize the internal information processing and reasoning while performing the procedures involved in a task. By experiencing teacher's cognitive process, students are better able to adopt the expert's mode of thinking (Gorrell & Capron, 1990).

The effectiveness of cognitive modeling has been demonstrated in many research studies. Bruch (1978) reported two experiments supporting the use of cognitive modeling. Denney (1975) investigated using cognitive modeling as a way of enhancing children's problem solving efficiency in a question-asking task. Three kinds of strategies were studied: cognitive modeling, watching people ask questions, and self-rehearsal of key strategies. Elder children benefited from all treatments, but cognitive modeling was the strategy that was used by most children from age 6 and up. In mathematics, students with difficulties also benefited from cognitive modeling and guided performance. Making the covert problem solving process observable for the learners by giving exemplary modeling and explanation of internal processes proved to be an effective way to scaffold students' performance. (Schunk, 1981, Welkowitz & Calkins, 1984).

Research conducted by Englert and Raphael (1988) indicate that cognitive modeling and coaching are also effective strategies for supporting expository writing. With their Cognitive Strategy Instruction in Writing program (CSIW), they taught special education students writing strategies through the use of think-alouds that model underlying writing process. In this program, they also used "think sheets" with prompting questions that help students focus on audience, purpose, background knowledge, organizations and steps of the writing. "Think sheets" also serve as a tool to help student think through the writing process reflectively. Evaluation results indicate positive results for using these strategies in teaching writing.

It is worth noticing that most implementations of cognitive modeling has been provided by think-aloud protocols. Students experience the covert and internal cognitive processes of the models through watching models' performance and listening to their speech explaining the process and strategies. With today's computer technology, we believe that it is possible to reveal model's cognitive process by providing explanatory descriptions of the process as learners attempt to solve problems. In this study, we explored an experimental implementation of coaching and modeling in a computer based, case-based learning environment. In this study, the instructional outcome is the ability to make an argument in support of purchasing decisions. In order to make sound argumentation, students not only need to assimilate the thinking process of the experts, but also need to articulate their own reasoning and thinking in a way that the expert would do. Cognitive modeling here serves as both model of reasoning process and model of desired behavior outcome.

Individual Differences in Using Modeling and Coaching

In this study, we attempted to investigate the interaction between the instructional treatments and the learning characteristic, locus of control. Locus of control describes an individual's generalized expectancy about how reinforcement is controlled, either by internal or external means. Individuals are internally oriented if they perceive a contingency between events in which they are involved and their own actions. Such individuals perceive events to be under personal control. Individuals who feel that they can influence the environment will actually seek ways to control the environment, when that control can be instrumental in attaining their goals. Externally oriented individuals perceive events as being unrelated to their behavior or characteristics, and thereby not under personal control. They tend to attribute the outcome of events to external factors (e.g., luck). Personal perceptions of causality have been demonstrated to be important mediators in many situations. As a psychological attribute, locus of control has been linked with the independent use and case-based learning environments.

Lefcourt (1982) identified some of the cognitive activities in that demonstrated differences between internals and externals such as information assimilation, attention, sensitivity to the meanings or reinforcement opportunities inherent in different tasks and situations, and concentration. He concluded that internals were found to be more perceptive to and ready to learn about their surrounds. They are more inquisitive; they are more curious and efficient processors of information than are externals. There is a trend of positive correlation between internality and academic achievement. Internals should be more adept at using learner-controlled, case-based learning environments.

Internal oriented individuals are more exploring, they tend to be more comfortable in the situation in which they need to make decisions. Internals should be better arguers. On the other hand, external individuals tend to believe that their effort does not make much difference in the outcome, therefore, they often rely on external lesson structures. They do not want to make decision because they believe that makes no difference. Therefore, it would be more beneficial to them if the lesson provides more supportive instructional strategies (Holloway, 1978; Carrier, Davidson and Williams, 1987).

Purpose and Hypotheses

The major purposes of the present study are

- To investigate and compare the effectiveness of two instructional strategies, modeling and coaching on helping students to articulate and support their decisions in a case-based learning environment.
- To compare the effectiveness of modeling and coaching on helping student address essential criteria in order to make sound decisions.
- To investigate how locus of control influences students performance.

This study tested the following hypotheses about modeling and coaching:

1. Students in the modeling treatment will write essays addressing more of the criteria than student in the control or coaching treatments.
2. Students in the coaching treatment will write essays addressing more of the criteria than student in the control treatment.
3. Students in the modeling treatment will write more integrated and coherent justifications than other students.
4. Students in the coaching treatment will write more integrated and coherent justifications than student in the control treatment.
5. External control students will benefit more from the modeling and prompting than internal control students.
6. Students who are more comfortable using computers perform better.

Method

Subjects

Fifty-five college students from two classes of School of Restaurant and Hotel Management at a large eastern university comprised the sample. Sample students ranged from the third to the fifth semester in college. Students were randomly assigned to three groups by their instructor. There were 17 students in the modeling group, 17 students in coaching group and 21 students in the control group. None of the students had any previous experience with the content or the instructional materials.

Instructional Materials

The instructional material was a computer-based instructional lesson (with three different versions) which consisted of three separate restaurant cases that required learners to select equipment for purchase and then justify their decision based upon the relevant information in the case. Each case was a restaurant under improvement. Students had access to and control of a variety of information in each case, such as the location of the restaurant, the requirements and expectation of the restaurant owner, the new menu structure and menu analysis, specifications of different pieces of equipment to choose from. They also could access a glossary of difficult terms and use a built-in calculator. Their task was to write a report describing and justifying the kinds of equipment to buy for each scenario. These decisions and justifications were recorded by the program.

There were 14 potential criteria that each student should think about before making the justification. These criteria were taught explicitly during the instruction.

Treatment 1: Modeling group. In addition to the core instructional materials, the modeling treatment provided students with a similar case scenario with think-aloud statements of the expert's decision on which pieces of equipment to purchase as well as the rationales and justifications for the decision. The modeling scenario was presented along with the articulated rationales and justifications in a field next to the window in which learners were required to write their justifications. In the expert's rationale, the reasoning processes were articulated and the criteria to be considered were addressed. This modeling section was available to the students while they were writing their own decisions and rationales.

Treatment 2: Coaching group. Students in coaching group also had the core instructional materials. Rather then a model of the performance, prompting questions were presented to focus their writing of the report. The questions prompted the students to think about the critical and relevant facts and the criteria when they are about to write the scenario. Sample questions are: "Have you gathered all the relevant facts from the case? " and "Can another piece of equipment perform this function equally well or better?"

Students in both treatments could return to the case scenarios and equipment specification database from the report writing section in order to obtain information to support their decisions. They were also permitted to revise their decisions later. The modeling and coaching were again available to each group respectively when they returned to the report writing section.

Treatment 3: Control group. Students in control group studied the core materials only without modeling and coaching in report writing section.

Procedure

Three groups of students used the software as an assignment for their class. All versions of courseware were stored on a university file server so that students had access to them. To help students to get the correct version of courseware, the three different versions were given different names and icons. Students finished the assignment in a one-week period and saved experimental data on floppy disks. The courseware saved version information, students ID and their reports. After finishing the program, data were collected by gathering data files recorded on students' disks.

Rotter's Locus of Control was administered after the assignment. After the Rotter's scale, the students were required to use a 5-point scale to indicate how comfortable they felt in working with computers.

Criterion Measures

Two readers scored students' justifications for all three scenarios on two scales. For each rater, the first scale is used to assess how many criteria were addressed in each scenario. This scale had 12 points that reflected the 12 criteria to be considered. Therefore, each student had 3 criteria scores. The average criteria score was calculated for each student. The second scale assessed how integrated and coherent the essays were in regard to the use of given information and the underlying reasoning process. This scale had 10 points and each student had 3 coherence scores for the 3 scenarios. The average coherence score was also calculated for each student. In judging the answers, we were more concerned with how well the students justify their decisions than with which piece of equipment they decide to purchase.

The inter-rater reliability was estimated. The correlation between average criteria scores was 0.75 and the correlation between average coherence scores was 0.77. In statistically analyzing the results, the average of two raters' scores were used as indicators for coherence scores and criteria scores.

Individual Difference Variable Measure

Rotter's Locus of Control Scale (1966) was administered to each subject after they finished the lesson as a measure of the locus of control. Locus of control describes individual's tendency to attribute successes and failures to internal sources such as effort and ability or external sources such as luck and fate.

Results

We use criteria scores to refer to the average scores obtained from the two raters on how many of the 12 criteria the students addressed in their reports and we use coherence scores to refer to the average scores obtained from the two raters on how integrated and coherent the students' reports were.

Table 1 presents the coherence scores achieved by the three groups, and Table 2 summarizes the analysis of variance (ANOVA). The ANOVA revealed statistically significant difference on coherence scores, F=46.49, P<.01.

Table 1
Coherence scores of three treatments

Treatment	N	Mean	SD
Coaching	17	8.15	0.51
Modeling	17	8.21	0.72
Control	21	6.06	1.01

Table 2
Analysis of variance for coherence score across three treatments

Source	SS	DF	Mean-Square	F-ratio	p
Treatment	58.71	2	29.35	46.49	.00
Error	32.83	52	0.63		

A Tukey post hoc test (p.< .01) indicated that students performed significantly better in both modeling and coaching groups when compared with the control group. However, there was no statistically significant difference in coherence scores between modeling and coaching groups occurred.

Table 3 presents the criteria scores across treatments, and Table 4 summarizes the ANOVA. No significant difference across treatments. F=0.148, P<.86

Measurement of locus of control was administered after the instructional treatments. Because some of the subjects did not turn in the questionnaire, we have 18,14, and 13 subjects' locus of control data for control, coaching and modeling group respectively. No significant differences among mean scores of locus of control occurred between the three treatments.

Table 3
Statistics of criteria scores of three treatments

Treatment	N	Mean	SD
Coaching	17	10.21	1.70
Modeling	17	9.86	1.60
Control	21	10.06	2.14

Table 4
Analysis of variance for criteria score across three treatments

Source	SS	DF	Mean-Square	F-ratio	p
Treatment	1.01	2	0.51	0.15	.86
Error	117.90	52	3.42		

There was no significant correlation between locus of control and coherence score. r=-0.12, p<.44. However, the correlation between locus of control and criteria score approached significant level. r=-0.29, p<.06. The correlation between locus of control and the criteria score led us to look more closely into these two measures. Modeling group had the least correlation between locus of control and criteria score. A linear regression of locus of control and criteria score for Coaching group showed a multiple R of 0.29.

Table 5
Analysis of variance for locus of control score across three treatments

Source	SS	DF	Mean-Square	F-ratio	p
Treatment	42.59	2	21.30	1.27	.29
Error	701.85	42	16.71		

Table 6
Correlation between criteria score and locus of control

Group Name	N	r	p
All groups	45	-0.29	.06
Coaching	14	-0.36	.21
Modeling	13	-0.11	.72
Control	18	-0.29	.23

No significant correlation between the self rating of comfort in using computers and criteria score and coherence scores occurred.

Discussion

Criteria scores indicated how many criteria students addressed. For a criterion to be judged as addressed, it only needed to be mentioned in the report. The fact that all of the 12 criteria were taught explicitly made criteria score a measure of recall of rules. The present study indicated that students performed equally well in all three groups. Providing additional prompting or coaching of selections criteria did not help students at the level of rule recall.

Coherence scores indicated how student analyzed the problem situation, applied the knowledge introduced in the courseware, and integrated and synthesized their solutions to the problem. Argumentation and articulation reflected higher level of thinking process and real life problem solving skills there would be needed in their future profession. By writing purchasing suggestions and rationale, they were trying to speak the language of the professionals in their field. The result of present study suggested that both coaching and modeling strategies enhanced students' performance in writing coherent and integrated rationales and argumentation. However, students in coaching and modeling group performed equally well, indicating that these two different scaffolding strategies were equally effective. Our current implementations of both strategies were not very sophisticated and still they enhanced performance significantly compared to that of the control group. However, we plan how students will perform with more sophisticated and more powerful implementations of coaching and modeling in an upcoming study.

Locus of control did not correlate to students' coherence scores. However, there was a negative correlation between externality of locus of control and criteria scores, and the correlation coefficient was approaching significance ($p<.06$). This confirms the result of past studies that internal student generally perform better than external students. However, initial data analysis indicates that in the modeling group the negative correlation between externality and coherence was least significant. The scaffolding afforded by modeling strategy might have helped external students keep up their performance with that of internal students. Because of the relatively small sample size, further study is needed to reach a more certain conclusion.

Conclusion

In a case based learning environment, students can make more coherent and integrated argumentation with either coaching strategies or modeling strategies as scaffolds of performance. Complex responses in case-based environments can be supported with a variety of strategies aimed at getting students to articulate their thinking. However, neither coaching nor modeling helped students to address more criteria (have better rule recall). Internal students outperformed external students. However, there was some indication that modeling strategy can help reduce the performance difference in rule recall between external and internal students.

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Title:

The Impact of Situational Factors on the Corporate Instructional Development Practitioner's Decision Making

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Background

Widespread change is dramatically altering the traditional face of the workplace. This is creating new problems and conflicts which call for new interventions and strategies. One of the emerging problems in the field of Instructional Development (ID) is the widening gap between theory and practice.

Over the years, the majority of ID studies at the macro level have focused on model building (Andrews & Goodson, 1980; Taylor & Doughty, 1988). In the past, theoreticians identified the critical ID component tasks, organized them in a logical, linear sequence and suggested that practitioners follow them systematically and thoroughly (Gustafson & Tillman, 1991). But, this strictly step-by-step procedure does not reflect the ID process as practiced in the field, since it is what works that counts in the product-oriented corporate world.

Until recently, little research had addressed the critical issue of "what works," let alone the crucial decision-making process involved in corporate ID practice or the quality of the decisions made. ID professionals may have to explore diverse human and situational factors in pursuing this line of research.

In examining the recent developments and future directions of ID, the literature revealed that special attention is now being given to social, political, and cultural influences. This, in turn, is leading to a shift from the early classical, mechanistic mode to a more flexible, situational and social approach to ID (McAlpine, 1992; Schwen, 1988; Stolovitch & Keeps, 1992; Tessmer and Wedman, 1990 through 1993; Tripp, et al., 1990).

In addition, a review of the literature on successful corporate ID practice provides insightful evidence that the ID practitioner's decision-making process is profoundly influenced by diverse situational factors (Gordon, 1986; Greer, 1992; Kaczmarek, 1992; Rowland, 1992; Steinburg, 1991; Wedman and Tessmer, 1993). But to date, the process of identifying, organizing, weighing, and prioritizing these factors, as well as the process of making decisions and visualizing the consequences have not been clarified by research.

Research into those ID processes which modify theory must be the engine which drives professional practice. Exploring both the ID context and the expert practitioner's decision-making process in the corporate setting could provide insights which advance ID theory and give practitioners a more realistic set of options. This article describes the two-year naturalistic inquiry which was committed to this goal.

From the researcher's point of view, this study proposes a conceptual framework which will advance ID theory, especially at the macro level which encompasses planning, development and implementation. From the ID practitioner's perspective, it explores and illuminates the influences of critical situational factors and the interaction between the practitioner and the surrounding context. This was accomplished by asking the following research questions:

- What are the critical situational factors which influence the corporate ID practitioner's decision-making process?
- How do the critical situational factors influence the corporate ID practitioner's decision-making process?
- What patterns exist in the dynamic interplay among the critical situational factors which can elicit a descriptive framework for what may be done, rather than a prescription for what must be done?

Situational factors in this study are defined as "a variety of environmental forces which influence the ID practitioner's decision making in a specific situation." These forces may act either as restraints or advantages for the practitioner. Five situational factors were identified from the literature: (1) individual characteristics, (2) resource availability, (3) client needs, (4) organizational influences, and (5) market competition. Market competition was excluded because it was beyond the scope of this study. Three new situational factors emerged during the course of the inquiry: (a) cultural context, (b) nature of the task, and (c) stakeholders. Together, these seven situational factors formed the core of this study.

The China Productivity Center (CPC), Taiwan, was chosen as the setting for this inquiry for several reasons. First, it provides a concentrated source of high quality corporate consulting and training services which could be observed in situ. Second, CPC carries out the government's policies for economic development by serving the nation's small- to medium-sized enterprises. Third, while many success stories exist in Asia's Pacific Rim countries, Taiwan's "economic miracle" is one of the very best examples. Finally, for corporations seeking to internationalize, Taiwan, with its unique location, history and economic achievements, serves as a gateway to Asia; and for Taiwan's business community, CPC serves as a gateway to the world.

In this article, I first describe the research method, then provide a summary of the context of the study. Next, the five cases of the four ID practitioners are presented in a condensed form. This is followed by a discussion of research findings. Finally, some promising areas for further research in corporate instructional development are identified.

Methodology

Heinich (1984) asserts that ID research efforts should focus less on telling practitioners what they should do, and concentrate instead on finding out what the conditions are that shape their decisions. By criticizing the laboratory approach as not compatible with instructional management realities, Heinich goes on to encourage ID researchers to engage in more naturalistic inquiry (the research paradigm as described by Lincoln & Guba, 1985). The present study followed this direction.

Winn (1986) also argues that it is imperative that the case study method be considered as a serious research tool for ID inquiry. In recommending this approach, Winn contends that, because there are certain common elements in every ID project, "how each of these (elements) is handled under different circumstances is very instructive, and usually adaptable to other projects" (p. 350). Therefore, in this inquiry, the qualitative case study, with its emphasis on *description* rather than *prescription*, is the method chosen to cast light on the dynamic interplay of critical situational factors on the ID practitioner's decision-making process.

Subjects

Four expert ID practitioners were selected as a purposive sample of subjects for this study. Edward, Mary and Emilie are Group Managers at CPC. Tony, a former Group Manager, is currently a Senior Manager at a major international insurance corporation. Their average age is 35 years; their average length of service at CPC is 6.5 years.

All hold bachelor's degrees, Edward in Mechanical Engineering, Mary in Law, Tony in Psychology, and Emilie in Graphic Design. Only Emilie has a formal ID education background (Master's in Instructional Technology). Edward, Tony and Emilie hold Human Resources Management (HRM) Consultant Certificates issued by CPC, while Mary has had extensive work experience in the non-profit sector. These four practitioners started their professional careers either as trainers or training coordinators. They have grown professionally and are well on their way to completing the transition from ID practitioners to holistic organizational consultants.

Data Collection

The duration of this study was January 1992 through July 1994. Preliminary inquiries were undertaken both in the United States and at the China Productivity Center (CPC) in Taiwan between July 1992 and December 1993. Historical and observational data were collected during this period. The focus period (January 1994 through April 1994) consisted of an in-depth study of the four key participants involved in the ID process at CPC. Post data analysis and report writing was carried out between May 1994 and July 1994.

The data collection techniques used were: (1) spontaneous conversation, (2) interview and discussion, (3) participant observation, (4) field notes and a reflexive journal, and (5) document and record reviews. The interview, discussion and participant observation proved to be the most powerful means for revealing the way the practitioners perceived and responded to reality.

Informal discussions (e.g., those held during the process of developing or managing the ID projects) often provided the most insightful discoveries of the "true" socio-political perspectives of the participants. This kind of discussion together with semi-structured interviews served as the primary tools of the inquiry. The interviews and discussions were conducted in a conversational tone to preserve the naturalness of the interaction.

Intensive participant observation was another powerful tool. I had been engaged in a dialog with these subjects and with CPC as an organizational entity since July 1992. I worked side-by-side with the practitioners, shared their frustrations and happiness, their struggles and celebrations on a daily basis. Participant observation thus provided me with an in-depth, here-and-now experience. It allowed me to live in the participants' time frame, to perceive the world as they saw it, to capture their emotional reactions, and to confirm what was being discussed.

Data Analysis

In a naturalistic inquiry, data collection is carried out simultaneously with data analysis. This enables the inquirer to focus and to shape his or her study as it proceeds. But in this article, these two processes are presented separately for the convenience of the discussion. A combination of different methods of data analysis was used. These included: (a) the constant comparative approach (Glaser & Strauss, 1967), (b) the modified constant comparative approach (Lincoln & Guba, 1985), and (c) data analysis strategies recommended by Merriam (1988).

My reflexive journal was used as the principal tool for the ongoing data analysis. The journal focused on (a) those issues and concerns which the interviewees addressed most centrally, (b) the main themes emerging from the interviews, discussions and observations, and (c) any speculations or guesses suggested during the interviews, discussions and observations.

Post data analysis activities included preparing data for analysis and analyzing for category and pattern. In preparing data for analysis, all of the information collected was first organized into a comprehensive resource package. The summaries were then transferred (together with any pertinent quotations) to 3X5 index cards. Each card carried a unit of information; that is, any relevant statement that stood alone without further emendation. Each card was then assigned three codes that corresponded to the respondent's first initial, the date of the interaction, the page number and sequence on the summary page (example: T/2-8-94/3.2). This code provided a means by which all data used could be located within the raw data sources.

In analyzing for categories and emerging pattern, I began by sorting the cards into categories which shared common properties, and then gave each category a tentative name. I cross-coded and duplicated those cards which fitted into two or more categories. The grouped cards were re-sorted and assigned a formal category name. I then wrote a thematic memo about each group of cards. These thematic memos were compared, analyzed and grouped again into larger patterns. Finally, I established theoretical constructs from the distillation of the patterns which emerged.

Context

In the past, Instructional Development has been more closely aligned with education than with business. The ID profession is growing rapidly and the market in public and higher education has become more crowded. An increasing number of practitioners are now entering the corporate world as trainers and consultants. The majority of corporate ID practitioners are either employed by private companies, serve in government agencies, or work for business consulting firms. The scenario of this case study represents a fourth option. The China Productivity Center in Taiwan is a government-business partnership for workforce development.

Taiwan

Taiwan's rapid economic development has brought it in three decades from an agriculture backwater to the 13th largest trader in the world. More recently, it has drawn international attention and acclaim for its political reforms. Taiwan's economic and political liberalization fostered the growth of pluralism, which in turn changed social structure and relationships. High rates of educational attainment, the emergence of a vigorous middle class, and expanded international trading networks are accelerating Taiwan's rate of social development.

Under great pressure to keep up with the rapid pace of change, corporate education has become a business strategy to stay profitable and to gain a competitive advantage. Many corporations in Taiwan send their employees to an outside vendor. While numerous private consulting firms provide training services, some government-business partnership are also heavily involved in workforce development. The China Productivity Center (CPC) is one of the best-known and most successful examples.

China Productivity Center

CPC was established by the government in 1955 to assist Taiwan's small- and medium-sized enterprises in improving their productivity and the quality of their services. Run as a non-profit government-private parternship, it has played a key role in facilitating Taiwan's economic growth.

Since 1955, CPC has carried out a range of activities which fall into three broad categories: (a) those directly connected to government, such as implementing productivity-related policies; (b) those in direct response to client needs, such as providing business and training services; and (c) support services for business in general, such as forming professional associations, producing trade and professional publications, establishing productivity-related university programs, participating in international organization, and facilitating social well-being.

Under the leadership of Dr. Casper Y. Shih, CPC has undergone three critical organizational changes since 1984. The newly decentralized organizational structure has created a climate of vitality and autonomy. Only a few technical professionals at CPC have ID backgrounds--most learn by self-study and on-the-job experience. ID practitioners at CPC often combine roles: organizational consultant, project manager, activity expert, instructional designer, technical expert, and administrative support.

Cases

Following is a summary of the five cases of the four experienced ID practitioners studied at CPC in Taiwan. The full text of the cases can be found in the original research manuscript (Liang, 1994). Some of the richness of the interactions which took place during the inquiry may be lost in this present form.

The first case describes how Edward carried out a government-sponsored project in the agricultural community. Case two tells the story of Mary's struggle with her team's transition from government-supported to profit-making status. The third introduces Tony's DWACT corporate ID model. Case four, Tony's second case, discusses typical problems which the practitioner might encounter in corporate ID work. The last case, Emilie's, is a synthesis of many of the features from the previous four cases.

Case One (Edward)

Since 1971, when Taiwan was expelled from the United Nations, the dream of Taiwan's government has been to reenter the international community. To this end, one of its strategies has been to participate in a variety of international organizations. Becoming a member of GATT (General Agreement of Tariffs and Trade) is just one of many examples. But, the most serious internal impact of participating in GATT is that local agriculture will no longer have the government's full protection. This policy is generating a great deal of resistance from local farmers.

The government requested CPC's assistance to reduce this resistance by facilitating a policy of discounting the production and marketing costs of agricultural products. CPC's mission included introducing the local farmers to contemporary management techniques, developing a core of outreach administrative professionals, and disseminating information about the government's agricultural policies. Edward was assigned as Chief Manager for this project.

The way in which Edward implemented this project differed from the traditional ID process both in terms of content and approach. He provided additional on-site consultations and arranged supplemental media promotion events to support the content of the activity. He chose a flexible, cyclical approach to the ID process. For example, when he grasped the essence of the problem(s), he would quickly reach a conclusion and then "map back" the whole process from the identified conclusion.

In the early stage of implementing the training activities, Edward focused his effort on the farmers. But, after closely observing the feedback and interactions, he decided to shift his focus to the government agricultural personnel because he realized that the latter was his real client. In other words, he wanted to channel his energy where it would have the most impact.

According to Edward, the instructors in this project were mostly CPC in-house professionals. This intensive involvement was motivated by several considerations: reducing potential resistance from the farmers to the follow-up consulting services, developing more CPC experts in this business line, and creating a market niche and repeat business for CPC.

Edward's wide business network enabled him to draw in a number of regional professionals to carry out this project. He and his team established several sites to disseminate the government's policies and to demonstrate their tangible accomplishments. The high visibility of the project results facilitated his client's buy-in.

Edward identified two major difficulties which he had to overcome during the project. The first was related to the unique nature of agriculture, e.g., farmers tend to have a conservative midset; their average level of formal education is low; they need to work during daylight hours. This influenced the timing of his team's activities and the way they communicated. The second was related to the mindset of some CPC staff who tended to think of agriculture as a low-end business. Edward now plans to capitalize on this experience to develop an Agricultural Enterprise Management Consultant program to foster outreach professionals--in anticipation of promising market.

Case Two (Mary)

Group A was formed at CPC in 1988 to promote Quality awareness. The group held annual Quality Month activities which usually included an opening convention, seminars on a topic chosen annually, various media promotions, as well as visits to exemplary companies. Because Quality month had been sponsored by the government, many CPC people believed that Group A was unable to support itself financially.

In mid 1993, Group A encountered a major challenge. The government decided that its Quality awareness policy had been successfully diffused throughout Taiwan's business community, and discontinued the group's annual supporting budget. Suddenly, the original mission of Group A was lost. Mary, the Group Manager, faced a tough choice: Whether or not to keep her group going.

Mary quickly held several meetings with her team members to announce this discouraging news, to exchange opinions and to consolidate the consensus. She simultaneously met with CPC top management to proclaim her team's intention and commitment, and to gain inter-organizational support.

After reaching a consensus and gaining team and management support, Mary did two things. First, she planned the next year's activities from their zero income base. Second, she took action to handle her team's transition both psychologically and behaviorally. To shift from its original "non-profit" identity to a "making-a-reasonable-profit" one, Mary led her team to identify what should be kept and what should be discarded. This shift involved a new mindset and subsequent behavior patterns.

During this tough time, Mary worked with her team members to experiment with the new approach. Experience was accumulated. New ideas and strategies bloomed and were carried out. As a result, the Quality Club and the Planning Professional seminar became two examples of the new ideas which bore fruit.

The Quality Club is an association of diverse corporations interested in quality issues. The strategy behind forming this Club was to ensure a basic business, to establish a communication channel with clients, and to create an environment for enterprises to establish information networks and to form alliances.

The Planning Professional seminar, on the other hand, was a strategy to build the team members' professional competencies. Mary developed this education activity by mimicking what she usually does. Believing that the process for many things is similar, Mary stressed that the continuous experience of communication, negotiation, implementation, and revision is a necessity, because corporate situations are always in a state of flux.

To achieve successful project outcomes, Mary used three key strategies: (a) knowing the critical success factors for different kinds of activities, (b) distinguishing "our success" from "our client's success," and (c) using the client's standards as her criteria.

Mary encountered two particularly difficult problems. The first was the need of providing a clear vision for her team, because she could not guarantee the team members anything. People had to overcome the anxieties about survival before they could concentrate on the mission. Performance evaluation was Mary's second problem. Quality awareness activities were large in scale and abstract in content, which made their achievements difficult to measure quantitatively.

Case Three (Tony I)

Fleet is a major corporation in Taiwan's automobile industry. Bill, the President, wanted to globalize his business. One of his strategies was to enhance Fleet's human resources with CPC's assistance. Tony conducted a series of human resources development projects for Fleet, which became known as the Fleet Project.

The Fleet Project continued for three years under Tony's leadership. In the fourth year, following a major internal re-organization at CPC, it was transferred to another newly-formed group. Within a few months of this "organizational earthquake," the new group encountered serious turnover problems and the project was terminated.

Before Tony took on the Fleet project, he considered several issues from CPC's stand point: Was this project for "survival" or for "development"? Would it create a market niche? Was he mentally ready for this project? Was he professionally equipped to handle this project? Were the resources adequate? and, How tough was the client?

Although Tony stressed that the Fleet Project owed its success to the strong support from top management, it was his effective approach which formed the backbone of the accomplishment. Tony used his experience with Fleet to develop the DWACT corporate education model (Diagnosis, Workshop, Action, Consultation, and Training). DWACT is an in-house, tailor-made corporate education service model (see Table 1). Although the five steps in the DWACT model are presented in a procedural format, the practical operation of this model is an overlapping, concurrent approach (see Figure 1).

Clearly, what differentiates the DWACT model from the traditional ID approach is its emphasis on action, the use of non-educational interventions, the consultation activity, and the concurrent pattern of activities. According to Tony, the three primary functions of this model are: to amplify the value and effectiveness of educational activities; to highlight the market differentiation; and to bring an impact to the client organization.

In the diagnosis process, Tony used the standard business technique of SWOT (Strength, Weakness, Opportunities, and Threats) to identify the client's problems, and at the same time he passed on his diagnostic skills to the client. Before carrying out the workshop presentation, Tony discussed his agenda with the client representative. He found and then got rid of those issues which conflicted with the Fleet organizational culture. Tony then designed the workshop handouts in several modules which could be combined according to the different needs of the participants. The client then executed Tony's recommended action plan. Tony and his team provided consulting help when requested. The training activities were conducted concurrently with the action deployment.

Tony's lack of familiarity with his client's core technology [specific industry, issues and terminology] was the major problem in the Fleet project. But, Tony indicated that this was not difficult to solve because CPC has accumulated a wealth of consulting experience over time. Thus, the practitioner's ability to maximize CPC's resources becomes central to the problem.

Table 1: The DWACT Corporate ID Model (Source: Internal CPC document, Pang, 1992)

DWACT Corporate ID Model
Diagnosis • Collect, categorize, and analyze the client's needs and problems via interviews and/or questionnaires. • Design and structure the activity deployment by tracing the desired outputs back to inputs. • Present the findings to the client and revise them based on the client's feedback.
Workshop • Arrange the necessary contextual considerations into the workshop. • Stimulate the participants' discussion via instruction, information sharing, simulation, group exercise, or by changing "the rules of the game." • Consolidate the participants' consensus and commitment, as well as construct an action plan.
Action • Deploy the action plan in concert with a cognitive change. • Coordinate and evaluate the action deployed, then present the performance outcomes to the client.
Consultation • Assist in improving the action. • Facilitate performance by giving feedback and advice.
Training • Re-equip and upgrade techniques necessary for the ongoing actions. • Enhance the background knowledge and skills of participants for the follow-up activities.

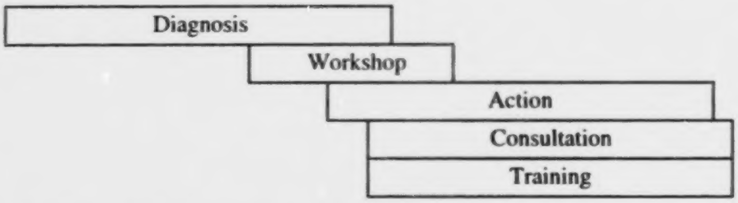

Figure 1: The Process Model of DWACT

Case Four (Tony II)

Informatics is a renowned government-sponsored research and development institute. Its main duty is to conduct R&D projects which promote the development of Taiwan's strategic industries. In addition, Informatics helps local hi-tech industries with their research activities. Because of its unique mission and characteristics, most of its operations must adhere strictly to government policies and regulations. Many professionals at Informatics had complained about the cumbersome purchasing process and the complexity of its project contracts. Informatics contracted with CPC to solve these problems. Tony was eager to take on this project because, if it succeeded, it would bring CPC great credibility. But, he also worried that Informatics' high expectations, its lack of experience working with ID practitioners and its internal politics would hinder his accomplishment.

After an in-house diagnosis, Tony concluded that Informatics' problems stemmed both from operational and policy-related causes. Although there was adequate room for improvement on the operational side, it would be difficult to get a radical improvement on the policy side due to the inflexibility of the regulations. But, the client could not grasp the complexity which the project might involve. Because of the political considerations, instead of taking a holistic approach to these problems, Tony decided to follow the client's ill-defined intention, and focus only on improving the operational process.

In addition to the difficulties identified above, many other problems arose during this project. The client's problematic internal cross-functional communication and a lack of top management's support were two major roadblocks. The problems associated with the practitioner side were: (1) the hidden agenda (Tony originally planned to transfer the leadership of this project to Joe, another CPC professional); (2) unexpected organizational change (Joe was assigned to lead a newly-formed group); and (3) the lack of knowledge about the client's industry.

Tony re-designed both the purchasing and contracting processes and trained the institute staff involved in the new working procedures. As a result, the cycle time of the operational processes was reduced by 40%, but the policy-related procedures were not improved. By examining the "whole task," the impact was not so significant. The client criticized CPC team's performance. Tony felt powerless and frustrated.

Case Five (Emilie)

Knowseeds is a major corporation in Taiwan's telecommunications industry. It contracted with CPC to introduce the Kaizen business philosophy and techniques. Top management at Knowseeds was highly committed to this effort. But, this commitment resulted in extra pressure on the Knowseeds employees, a pressure which demanded visible results. Michael (Manager of Department C at Knowseeds and representative to CPC) felt the most stress. Not only did the pressure come from Knowseeds as a whole, but from his own division, because Department C had long enjoyed a reputation for high performance.

However, by its nature, Kaizen is not a business strategy which lends itself to fast success or quick fixes. And, Department C's consistent history of high performance left it little room for improvement. Thus, its opportunity for impressive results was much smaller than that of other departments with lower performance. Moreover, at the beginning of this project, Knowseeds incurred some inevitable start-up costs and the employees were required to institute economies in their customary operations. Subsequently, a variety of problems arose.

Dealing with the Knowseeds employees' reactions was the first problem. These workers had to change their operating procedures when quality techniques were introduced. But, the profits gained from this change were not credited to the efforts of these front-line "Kaizen-implementers." They felt exploited. The second problem was related to investment-return. Businessmen usually look for a fast return on their investment. This is reflected in their attitude when contracting for training or consulting services.

The third problem was the practitioner's unfamiliarity with the social dynamics of the client system, particularly the interpersonal networks, hidden agendas, readiness for change, resource allocation and response to evolving situations. Additionally, Emilie wrestled with the values and nature of her profession by asking: What is your professional aim? Who exactly do you want to help in your profession? What and how do you want to contribute to this society?"

A couple of months after initiating this project, Michael (the Knowseeds' manager) became impatient at the delay in outcomes. He did not want this project to hurt his reputation. He began to dispute certain issues with Emilie and her team members. Emilie found that Michael often chose approaches which would produce immediate and visible results, but which might not lead his department or Knowseeds to a better future. As the tension rose, Michael's management style changed, gradually shifting from a coach to a monitor of his subordinates.

In this project, Emilie decided to lead the client organization to reform its related policies and regulations, e.g. the incentive system. She wanted to ensure that productivity was rewarded and to prevent devious employees from taking advantage of the fluid situation.

Discussion of Findings

These five cases represent the initial effort to distill the raw data collected during the inquiries. The follow-up distillation of the data, which integrates the research questions and literature review, draws out the critical situational factors which were found to influence the practitioners' decision making. The findings are then formed the subsequent theoretical constructs. In this section, the findings of this inquiry are discussed under four themes: (a) situational factors, (b) interlacing network, (c) decision-making process, and (d) corporate ID practice.

Situational Factors

Five situational factors in the ID process were initially identified from the current literature. These were: (1) individual characteristics, (2) resource availability, (3) client needs, (4) organizational influences, and (5) market competition. Market competition was excluded because of the limited scope of the study. During the course of this inquiry, three additional situational factors emerged: (a) cultural context, (b) nature of the project, and (c) stakeholders. These three new factors were combined with the original four, forming a core of seven situational factors which are addressed below (see Table 2).

Table 2: Key Situational Factors in Corporate ID Practice (from research on "The impact of situational factors on the corporate instructional development practitioner's decision making," Liang, C., 1994)

Key Situational Factors in a Corporate ID Project

	Client's Needs	The goals, expectations, intentions, standards, agendas, policies, and the specific demands of the industry of the client.
New	**Cultural Context**	The specific environment in which the ID project is carried out under a set of shared cultural traditions, values, beliefs, and the influences of contemporary social issues and concerns.
	Organizational Influences	The effects of the mission, values, culture, structure, and politics of the practitioners' system on the operations and outcomes of the project.
	Individual Characteristics	The academic background, work experience, personal values, status in the organization, professional competencies, and interpersonal networks of the practitioner.
	Resource Availability	The personnel, budget, time, materials, facilities, information and other resources necessary to implement the project.
New	**The Nature of the Project**	The tasks, scope and priorities of the project handled by the practitioner.
New	**Stakeholders**	The needs, concerns and benefits of those participants who have an interest in, or affected by, the activities and outcomes of the project.

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The client's needs were found to be the *most critical* of the seven situational factors in the experienced practitioners' decision making. The factors of cultural context, organizational influences, individual characteristics, and resource availability were *critical in all five cases*. The nature of the project and stakeholders were less critical but still *significant*.

This study demonstrated the primary importance of the client's needs in the practitioner's decision making. Each of the four practitioners put their clients' needs as their first priority and took their clients' tangible requests or vague hints seriously in order to ensure the projects' success, stay in business, and make a profit.

The cultural context was the first of the three new situational factors found in this study. Localizing materials was an example. To localize means to get rid of or to modify some notions which conflict with local culture and to add regional examples in order to make sense to the local audience. Many of CPC's educational materials are imported from Japan or the United States. The practitioners translated and then customized these materials to match their clients' needs.

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Organizational influences repeatedly proved to be significant throughout all five cases and had a profound impact on each practitioner's daily operations. This factor was also a major source of the practitioners' professional ethics. Organizational influences flowed through to the client systems by way of CPC's triadic business strategy of kaizen, innovation and anticipation.

The factor of individual characteristics was also significant in all five cases. In addition to the practitioners' professional competencies, other aspects of individual characteristics were especially noticeable: in Edward's case it was his interpersonal relationships; in Mary's case it was her previous non-profit work experience; in Tony's cases it was his business capacities; and in Emilie's case it was her personal values.

Resource availability was a significant factor in Tony's Fleet project and in Mary's transition case, but for different reasons. While Tony was amply supported by his client, Mary had lost her major source of financial support. Resource availability was not usually a major concern to these four practitioners, because funding for many of their projects came either directly or indirectly from the government. In fact, these experienced practitioners had also worked hard to become "resource-smart" people. Thus, the novice practitioner who wishes to become "resource-rich" should become "resource-smart" by first becoming "resource-conscious".

The nature of the project emerged as the second new situational factor which has significant impact on the practitioner's decision making. For example, the complicated nature of the contracts in Tony's Informatics case and the long-range timeframe of the Kaizen strategy in Emilie's Knowseeds case were examples which demonstrated this influence.

Stakeholders emerged as the third new situational factor. For example, in Edward's case, it was the characteristics of the farmers (e.g., their education level) which influenced his decisions on the design of the training materials and the methods of delivering and communicating concepts. The opinions and concerns of the other stakeholders, the agricultural administrators and scholars, also had determining effects on his project decisions. Emilie's concerns about the reactions and welfare of the Knowseeds employees was another example of the emerging focus by practitioners on stakeholders' needs and benefits.

Interlacing Network

A pattern was evident in the dynamic interplay among the seven situational factors which emerged in all five cases. Throughout each project, these factors influenced each other and developed their own sophisticated, interlacing network. Each factor had its links to the others. Some of these links were solid, while others were subtle. It was the immediacy of the relationship that made the links solid. The subtle links became solid in a specific instance when a close relationship occurred. Figure 3 proposes a construction of this interlacing network of situational factors.

The factor of individual characteristics is used here as an example to explain the nature of the linkages among the situational factors. The link between individual characteristics and cultural context is solid because Taiwan society is where these practitioners grew up, live and work. Resource availability is directly influenced by the quality of the practitioners' interpersonal relationships. Organizational influences (CPC's unique mission, values, culture and leadership) stimulate their thoughts and guide their professional conduct. Their personal traits and professional competencies determine if these practitioners' capacities match their clients' needs and whether or not they are likely to fulfill their clients' goals.

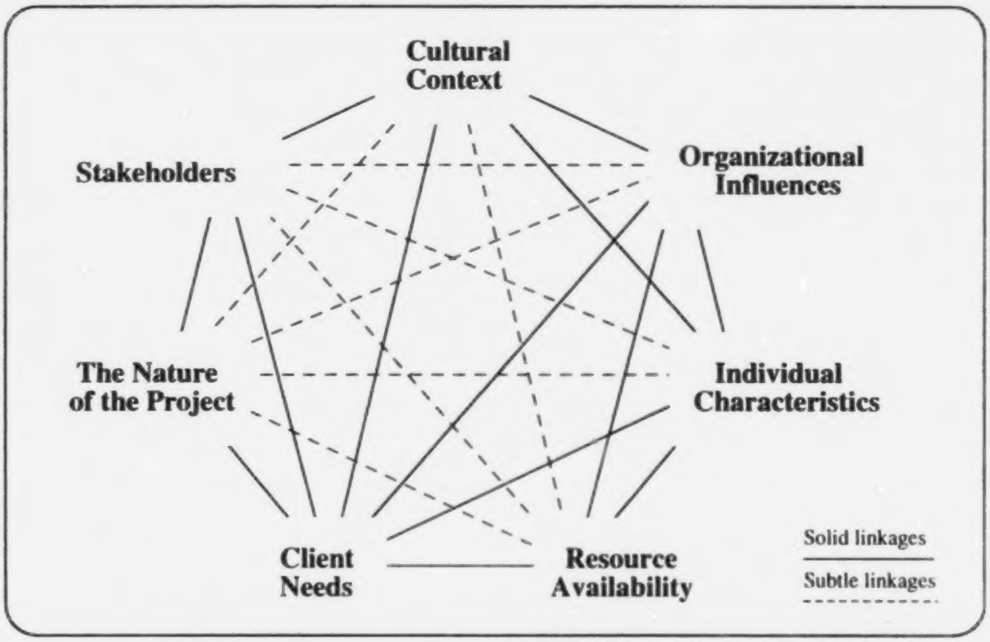

Figure 3: Interlacing Network of Situational Factors (from research on "The impact of situational factors on the corporate instructional development practitioner's decision making," Liang, C., 1994)

Usually, the factor of individual characteristics does not have a close association with the nature of the project or the stakeholders' benefits. But, in Mary's team transition case, individual characteristics and the nature of the project did become closely related. Because Mary's job had been non-profit in nature, this "habitual domain" psychologically hindered her professional practice during her team's transition to self-supporting status. In Emilie's Knowseeds case, the link between individual characteristics and stakeholders became solid because of her personal values. In asking who exactly a corporate ID practitioner wants to help, she was expressing concern about the Knowseeds employees' reactions and benefits.

As the data emerged, the interlacing network of situational factors proved to be an important construction which could track the practitioners' decision-making processes. This network showed how they analyzed the causes, current status and developmental directions of the problems they encountered. It provided a mental framework which could be used to visualize possible actions and the resulting consequences, and to create a prioritized list of the action events.

Decision-Making Process

Each of these experienced practitioner's decision-making processes were greatly influenced by a variety of external physical, intellectual and social forces existing in the surrounding context. It was the interplay of these forces which formed each specific project situation. The practitioners then made their decisions based on their interpretation of each situation and its context.

When the practitioners encountered a decision point, they explored the problem which had brought them to this decision point and delineated the readily identifiable situational factor(s) relevant to the problem at that time. They then mentally analyzed the sophisticated relationships among the specified factor(s) and the other situational factors.

The practitioners constantly updated their knowledge about the problem by seeking out new information from the context and/or searching for patterns which matched their previous experiences. They took account of the subsequent change in the relationships among the situational factors.

This continuous interaction with the situation enabled the practitioners to move gradually from involvement in each single situational factor to a consideration of the entire relationship; from an exploration of the problem to a commitment to the situation (refer to Figure 3). In short, they held a reflexive conversation with the situation.

Bearing the project's goal in mind, the practitioners then used their renewed knowledge to construct possible courses of action and to reason out possible consequences for each of these actions. Subsequently, the practitioners mentally developed a prioritized list of action events based on their intuition and/or judgment by visually rehearsing and comparing possible combinations of actions and outcomes. They then implemented the action(s) they had selected by following that priority.

Throughout their projects, the practitioners continued the processes of seeking out new information and searching for patterns in prior experiences to assess the emerging situations. Or, they moved in a similar way to address the new decisions which resulted from the actions they had undertaken.

Figure 4 proposes a construction of the practitioner's decision-making process. As the figure shows, decision making is a dynamic process in which continual exploring, searching, analyzing, constructing, prioritizing and visualizing activities may be carried out simultaneously or sequentially. It is further proposed that these activities take place within the architectural structure of the interlacing network of situational factors.

Edward decided to shift his focus from the farmers in his workshop to the government personnel because he was concerned about the project's eventual effectiveness and his client's satisfaction. At this decision point, client's needs and the nature of the project were the key situational factors which were immediately related (solidly-linked), while the stakeholders and resource availability were the more distantly related ones (subtly-linked). Edward decided to put the client's needs as his first priority because he had grasped the essential relationship among these situational factors.

He had perceived that it was the client, and not CPC, who would provide most of the ongoing support and resources (experts, capital, facilities and information) which would facilitate the project's success. It was also the client who had a closer relationship with the farmers and could diffuse what had been taught. This already solidly established relationship, combined with an effective diffusion system, would benefit the farmers and fulfill the government's policies, as well as stimulate repeat business for CPC.

In Edward's decision-making process, he continually sought out new information (e.g., through meetings with the client and reading suggestions from the post-training evaluation questionnaires). He also searched for pattern matches by reviewing his previous experiences, and he asked himself who his real client was. The updated knowledge not only helped him clarify the nature of the problem, it also deepened his understanding of the interrelationships of the situational factors involved.

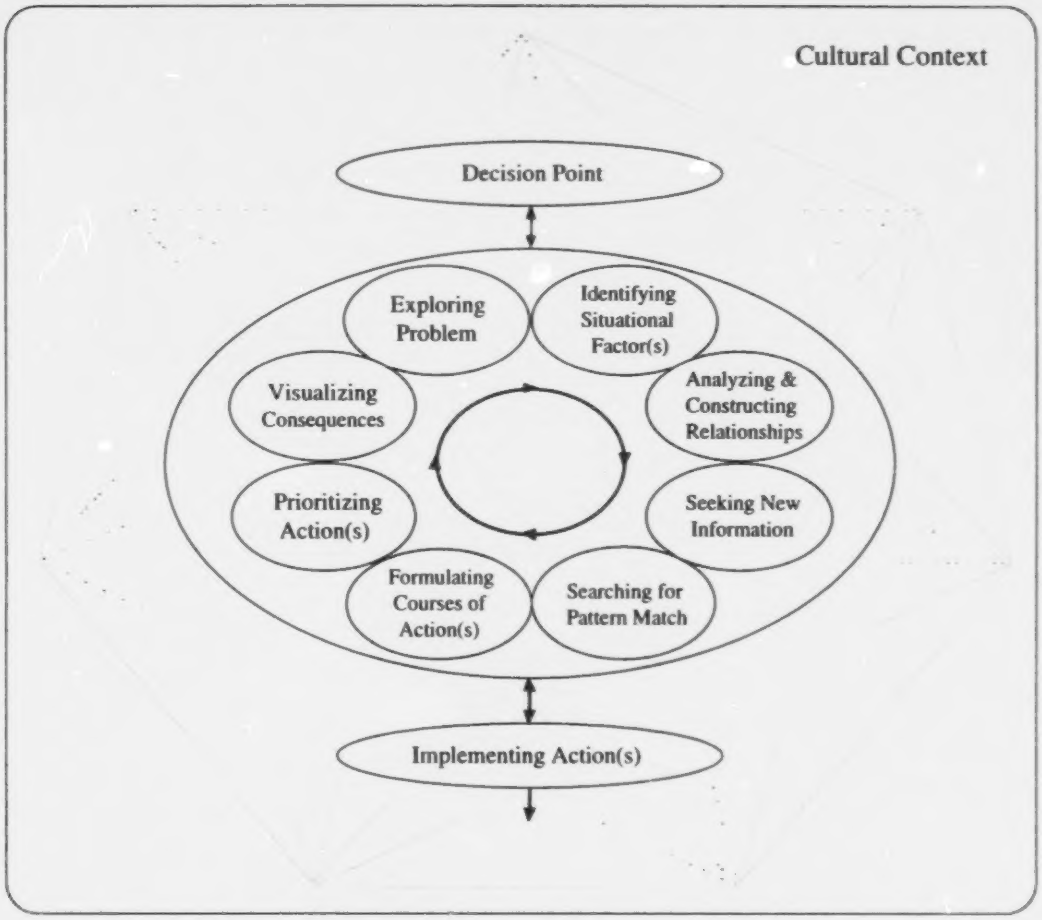
Cultural Context
Decision Point
Exploring Problem
Identifying Situational Factor(s)
Analyzing & Constructing Relationships
Seeking New Information
Searching for Pattern Match
Formulating Courses of Action(s)
Prioritizing Action(s)
Visualizing Consequences
Implementing Action(s)

Figure 4: Model of the Corporate ID Practitioner's Decision-Making Process
(from research on "The impact of situational factors on the corporate instructional development practitioner's decision making," Liang, C., 1994)

In Mary's case, her team encountered a crisis because of its loss of financial support. Its survival depended on whether it could successfully generate support from both its organization (CPC) and its clients (Taiwan businesses). At this decision point, organizational influences and client's needs became the critical situational factors. After mentally analyzing the problem, Mary began to gather more information and build support by discussing the situation and possible actions with her team members and top management.

These discussions brought out numerous innovative ideas for creating market niches. The consequences of each idea were then examined against the criteria of profitability. Mary then gradually moved from exploration of the problem to a commitment to the situation. Subsequently, the Quality Club was formed both to secure a basic source of revenue and to create an information network to the business community. The Planning Professional seminar was carried out to enhance her team members' professional capabilities, and to equip them for the long run.

In taking on the Informatics project, Tony followed his client's intention of improving the contracts process only. He mentally and operationally went through the same reflexive decision-making process as Mary. Likewise, Emilie's decisions on reforming the Knowseed's incentive system and her strategies for moving beyond the role of an ID practitioner shared the same characteristics.

The findings of this inquiry answer the original research questions. They also suggest answers to the following additional questions:

- How does the experienced ID practitioner arrive at decisions that a choice or action is feasible in an identified situation?
- What strategies do the experienced practitioner use in diagnosing a situation? and
- How does the experienced practitioner's choice of action fit within the broader framework of his/her reasoning about the situation?

Corporate ID Practice

Throughout this inquiry, the findings have consistently shown support for the perspective of ID as an eclectic discipline. Whether or not ID activities refer to a specific process, to a set of criteria, or to a social intervention, appropriateness emerges as the key. Effective ID involves a subtle and sensitive blend of all the above perspectives, which varies according to the needs of the project, the context in which the project takes place, and the people involved in that project, especially the client. Experienced practitioners are flexible enough to adjust their mindsets and approaches according to the different needs and situations which evolve.

This inquiry also supports the contention that ID is an interdisciplinary profession. In order to perform effectively, experienced ID practitioners transcend the boundaries of their professional discipline. This transcendence enables them to make significant contributions to the clients they serve, and to the society in which they reside. ID as an interdisciplinary profession becomes even more appropriate in the emerging "boundaryless" corporate environment.

This inquiry shows its concurrence with and bias toward recent developments in ID which acknowledge diverse social, political and cultural influences on professional ID practice. Experienced practitioners are sensitive to any newly emerging situations and willingly adopt a more flexible approach to their projects. They emphasize action-taking and action-learning, and offer both educational and non-educational interventions. These practitioners lead high-performance teams competently and demonstrate the ability to execute many assignments concurrently. They satisfy their clients, accommodate the stakeholders, and they promote their organization's interests and their own professional growth at the same time.

Based on the findings of this inquiry, a conceptual framework for corporate ID practice was created. This framework is descriptive in nature and refers to no specific technical procedure. It operates within the architectural structure of the interlacing network of situational factors. As the conceptual framework illustrates in Figure 5, in a particular cultural context, the process of a corporate ID project brings the practitioner and client systems together.

Three major activities take place: diagnosis, action and evaluation. These are carried out either sequentially or concurrently, as diverse situations continually evolve. The diagnosis activity includes needs and performance capacities analyses. Action represents the implementation of resolutions. Evaluation consists of performance evaluation and revision. The client, practitioner, and relevant stakeholders are at the confluence of the three activities. Endeavors devoted to creating values for these participants are situated in this central realm. The interface between activities and participants, the three overlapping segments of any two activities, are areas full of continual communication, negotiation and interaction.

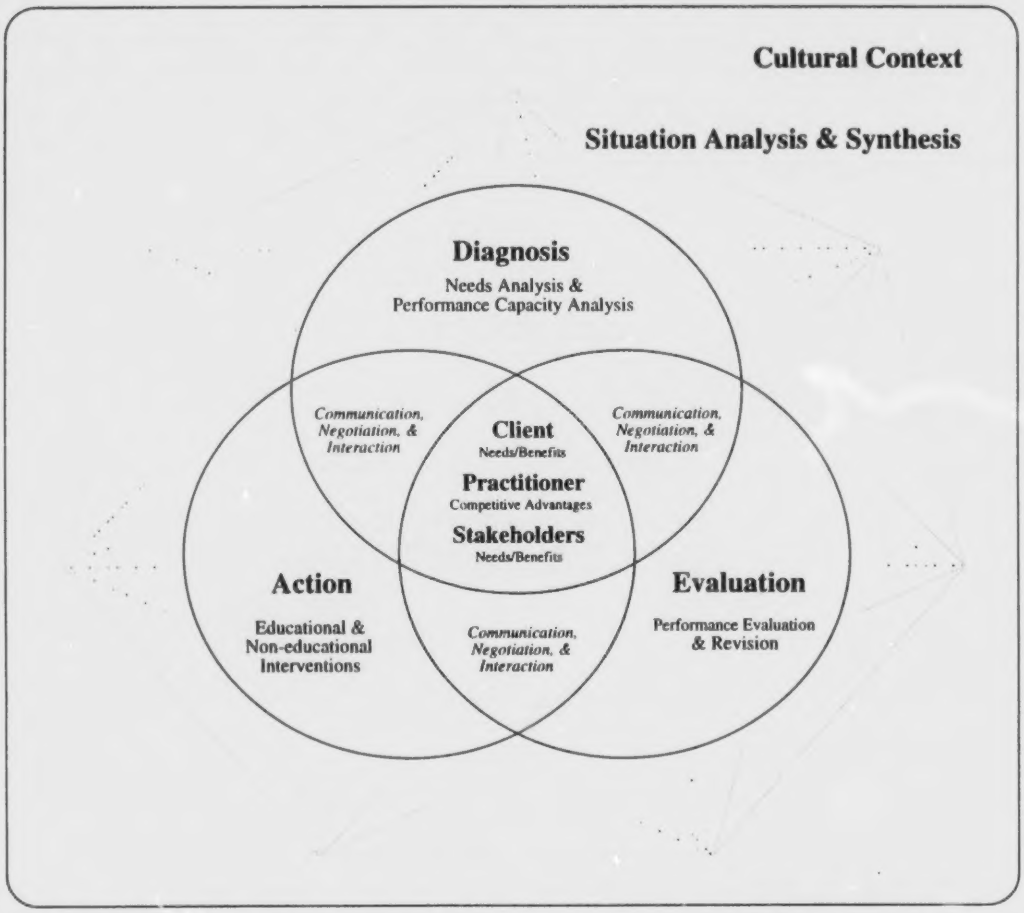
Cultural Context
Situation Analysis & Synthesis
Diagnosis
Needs Analysis &
Performance Capacity Analysis
Communication, Negotiation, & Interaction
Client
Needs/Benefits
Practitioner
Competitive Advantages
Stakeholders
Needs/Benefits
Communication, Negotiation, & Interaction
Action
Educational &
Non-educational
Interventions
Communication, Negotiation, & Interaction
Evaluation
Performance Evaluation
& Revision

Figure 5: Conceptual Framework of Corporate Instructional Development
(from research on "The impact of situational factors on the corporate instructional development practitioner's decision making," Liang, C., 1994)

Cultural context in the conceptual framework represents a complex network in which traditional values are interwoven with contemporary values and issues. Cultural context acts as a filter to help the project participants preserve things that fit, but screen out those that do not. It directs the participants' behaviors based on their belief systems.

An ongoing situation analysis and synthesis is carried out throughout the project to help the practitioner make decisions and to guarantee performance quality. The practitioner grasps the critical situational factors and their interrelationships, and then takes strategic action(s) to optimize the situation and to achieve full utility of the resources available to him/her.

The diagnosis activity is aimed at exploring both the client's business needs and the practitioner's performance capacities. Negotiation permeates this activity. The continual dialectic between the practitioner and the other project participants clarifies ill-defined project goals, or restructures or reinforces the established ones. The core agenda is to reach a jointly satisfactory match of needs and capacities.

While on the client side, needs analysis has been explored thoroughly in the ID literature, on the practitioner side, performance capacity analysis has received little attention and has seldom been addressed. An analysis of performance capacities should include a precise scrutiny of the available means (e.g., professional competencies and resources) necessary to implement the project. And, it should be done from the practitioner's, the client's and the stakeholders' perspectives. It should encompass an examination of the practitioner's values, mindset, and professional ethics.

The action activity implements the mutually agreed on resolutions developed from the diagnosis activity. If the problems identified are knowledge and/or skill deficiencies, then educational interventions such as training or job aids are proposed and carried out. Relevant techniques are taken into account, e.g., task analysis, instructional strategies, media selection, design and production of materials. But, if the problems are related to performance discrepancies, then non-educational interventions are suggested and implemented, e.g., motivating, promoting communication, supplying timely feedback, redesigning jobs, or reforming the organizational structure.

All the interventions employed to resolve these problems are situation-specific, and are directed toward purposeful action. In order to optimize the effect of the solutions, the interventions must be linked to the client's system and become an organic part of their daily operations.

The evaluation activity encompasses both ongoing performance evaluation and revision. This activity is an effort to create a joint agreement about the project's worth, similarly proposed by Coleman, et al., (in press). The critical concerns of evaluation are: the practitioner's ethical reflections, the resolutions of the consulting subject, allocation of project resources, the client's agenda, the social dynamics of the client system, the impact on both the practitioner's and client system, and potential for the repeat business.

A corporate ID project may include all of the above three activities (diagnosis, action and evaluation) or any combinations of these. The project may start from, or end at, any activity. Either starting or ending a project is enacted at the overlapping areas of any two of these three activities.

These three overlapping areas, the interface between the participants and the activities, are filled with constant interactions among the project participants. These are the areas rich with different perceptions, experiences, values, and cultures, i.e., areas crowded with "human obstacles" as termed by Arnn & Strickland (1975). It is in these interfacing areas that the project participants identify and overcome various human obstacles. Tasks conducted in these areas may include communicating, negotiating, compromising, reviewing, contracting, and managing or terminating the project.

All efforts engaged in the project are aimed at creating values to the client, to the relevant stakeholders, and to the practitioner. The practitioner, while maintaining standards of professional ethics, exercises his/her competitive advantages and strives for the project's success. Success emphasizes win-win outcomes--not only economic objectives, but the achievement of "social satisfaction"--delighted clients, satisfied stakeholders, and professionally evolving practitioners.

Future Directions

This study has opened many areas worthy of further exploration. These areas are synthesized under two major themes: (1) corporate ID practice in general, and (2) the experienced practitioner's decision-making process in more specific detail.

Corporate ID Practice

Future research on corporate ID practice might focus on this topic in different contexts (e.g., private corporations, academic environments or other cultural contexts) and/or with different methodologies (either under a naturalistic or positivist paradigm). Far more study is needed on the concepts identified in this inquiry such as the situational factors and conceptual frameworks. Following is a partial list of suggestions which promise to provide fruitful results.

Situational Factors
- the critical elements in each situational factor, and
- the effects of these critical elements on the practitioner's decision making.

Conceptual ID Frameworks
- the process models generated from the emerging frameworks,
- the prescriptive or descriptive guidelines developed from these emerging frameworks or process models,
- the process of situation analysis and synthesis,
- the criteria for, and process of, performance capacity analysis,
- the effect of relationships among different types of clients and stakeholders on the practitioner's decision making, and
- the effects of different business strategies on the practitioner's decision making.

Decision-Making Process

Given the results of the present study, several questions regarding the practitioner's decision-making process remain unanswered. Themes recommended for further study to extend the research begun here are: (a) the individual practitioner and project team, and (b) corporate ID training.

Individual Practitioner and Team Issues
- the types of decision-making errors made in ID project,
- the strategies for handling these decision-making errors,
- the effects of various stressors (e.g., time pressure) on decision making,
- the strategies for overcoming project problems with incomplete and/or inaccurate information,
- the effects of increased hands-on experience on decision making,
- the effects of increasing knowledge of the subject matter on decision making,
- the major issues in corporate ID *team* decision making, and
- the process and strategies of *team* decision making.

Corporate ID Training Issues
- the curriculum for training ID practitioners in situational assessment and decision making skills, and
- the instructional methods or strategies for training ID practitioners in situational assessment and decision making skills.

The answers to these questions promise to significantly improve our understanding of corporate ID decision making, as well as provide an intellectual foundation for advanced studies of professional ID practice in the corporate setting.

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Title:

Linear and Non-Linear Hypertext in Elementary School Classroom Instruction

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Abstract

This exploratory study was designed to introduce hypertext as a component of classroom instruction in a situation similar to that which might prevail in a public school setting. Linear and non-linear treatments of the same text content were employed as an information source for a supplemental learning task prescribed by a teacher as part of classroom instruction. The participants were elementary school children grouped by experience with video game technology in order to study the influence of that experience on their performance and satisfaction with the two hypertext versions. Performance was assessed by a student activity sheet, a delayed post-measure, and an attitude survey. There were no significant main effects or interactions found for any of the dependent variables. A post hoc exploratory analysis revealed a significant main effect for gender on attitude toward lesson organization. Males found the lesson, regardless of treatment, more clearly organized than did females.

Linear and Non-linear Hypertext in Elementary School Classroom Instruction

Hypertext is a form of text made non-linear through integrating a system of nodes and links. Each node of information (often a paragraph) may be linked to any number of other nodes, which are themselves linked to yet other nodes. The nodes of text are interconnected through this potentially complex series of links, which can be organized to convey a variety of conceptual relationships (e.g. hierarchical, spatial, chronological, semantic) alone or in combination. The nature of these linking relationships may or may not be labeled or defined for the user.

The hypertext user moves from node to node through the linked web of textual information by selecting a link from among those available at each node. The resultant path through the text cannot be predicted with certainty by the hypertext author, and may vary greatly from user to user. The effect of this random access within the hypertext document is "to overcome the strictly sequential medium of print and paper" (Marchionini, 1988, p. 8).

The hypertext concept of allowing unlimited quantities of knowledge to be stored, organized, and retrieved by the user in any organizational scheme desired, is intuitively appealing, but has been difficult to define. The fact that the technology which allows the creation of hypertext is emerging and changing even as hypertext is being invented and refined makes defining this medium even more difficult, nevertheless, numerous definitions have been proposed. Aust and colleagues (1993) have done as well as anyone: "Hypertext is an array of emerging technologies for accessing, organizing, and relating electronic-based information." As the technology developed to allow visuals, sound, and video to be stored and arranged in conjunction with text, the term hypermedia was coined. Ramaiah (1992), in a summary of hypertext issues, offers this definition: "When a multimedia program is developed in a hypertext environment, the resulting product is called hypermedia."

This definition, of course, raises the question of what constitutes a hypertext environment. Mark Horney (1991) has specified defining characteristics of a hypertext environment: (a) information stored in freestanding nodes, (b) nodes connected by associative links, (c) active engagement required of users and authors, (d) the system not dependent on any particular informational structure or medium of presentation.

Although not a new concept, hypertext has been readily available for instructional use only since the recent introduction of Hypercard and similar software for personal computers. This availability has generated interest in potential instructional applications of hypertext. Interest has resulted in the appearance of numerous theoretical, conceptual, and speculative essays on hypertext. Reviewers of this literature (Tsai, 1988; Heller, 1990; Ambrose, 1991; Park, 1991) have identified characteristics of hypertext such as non-linear structure, linking ability, and ability to adapt to or support a learner's associative thinking processes.

In addition to identifying characteristics, the reviewers of hypertext literature often list problems associated with learner use of hypertext. Jonassen (1988) provides a typical list of items: (a) navigation through hypertext, (b) selecting an appropriate user access point within a hypertext document, (c) integration by learners into their own knowledge structure what has been learned in the hypertext, (d) cognitive overload caused by the richness of non-linear representation.

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Research and Theory

One area discussed by theorists but not directly addressed by research is the issue of hypertext as a new discourse form and the related issue of developing a rhetoric for that form. Norton (1992, p. 42) maintains that "Hypertext/hypermedia as discourse suggests that knowledge can be derived not only from hierarchical, analytical relations of superordinance and subordinance, but also as complex networks which transcend narrow, disciplinary boundaries." According to Norton (p. 40), this leads to ". . . a shift in both the process and outcomes of knowing." Bevilacqua (1989, p. 162) says, "Over time and use, hypertext will probably change our way of thinking. . . ." Slatin (1990, p. 871), in his discussion of a possible rhetoric for hypertext, points out that presently, "The assumption that reading is a sequential and continuous process is the foundation on which everything else rests." He goes on to identify three classes of hypertext readers: browsers, users, and co-authors. "The relationship between these three classes can be fuzzy and therefore difficult to manage" (p. 875).

The published literature on hypertext contains relatively little experimental research. Jonassen's (1988) assertion that, "Hypertext design is theory-rich and research-poor," remains accurate today In the hypertext research literature, many studies deal with large hypertext database systems, which Rada (1991) has termed "large volume" or "macrotext." These studies address issues such as the use of browsing tools to aid in navigating through large hypertext database systems containing numerous documents (Nielsen, 1990). "Small hypertext", (microtext), consisting of single documents or lessons, can now be authored and used on inexpensive personal computers in classrooms and other instructional settings. At this time, there is relatively little research to guide the design or effective utilization of this instructional hypertext.

Of the studies exploring instructional applications of hypertext, only a few address the implications of its characteristic of non-linearity in an instructional setting. Yet, in the literature, the hypertext problems most frequently cited relate directly to the non-linear nature of the medium. A variety of terminology is used to describe this problem area, including: cognitive overload, getting lost in hyperspace, unmotivated rambling, and disorientation. The theorists suggest that hypertext may be too unstructured and confusing for learners to use efficiently and effectively.

The experimental results with instructional hypertext have been limited and mixed. McGrath (1992), Way (1992), Lin (1991), Lanza and Roselli (1992), and Harris (1990) all tested students' mastery of lesson content after completing alternate versions of the same lesson. In each study, a non-linear hypertext version was compared to one or more linear presentations of the same text.

McGrath (1992) compared four treatment types: hypertext, CAI, paper and a "NoMenu" linear computerized text. College undergraduates were assigned to high and low spatial skills groups and received instruction in calculating surface area and volume. While the study focused primarily on the issues of learner control and student misconceptions, the treatments varied as well in linearity. Subjects in the paper treatment group scored highest on the post-test problems, followed by hypertext, CAI and NoMenu. The hypertext group took the least amount of time to complete the lesson.

Way (1992) compared three lesson treatments: non-linear hypertext, linear CAI, and linear CAI with repetition option. The subjects were college undergraduates. The lesson dealt with basic psychological terms. While there were no significant differences in post-test achievement scores, the hypertext group took significantly longer to complete the lesson. However, a post-hoc examination of learners' paths through the hypertext showed that those in the hypertext treatment group who selected a non-linear path through the lesson, completed it in the same amount of time while still scoring as well as students in the other two treatments.

Lin (1991) compared linear and non-linear computer-based word processing tutorials with college-age subjects. Two of the three treatment groups were given the same hypertext instruction. One of these hypertext groups received ten minutes of training and practice on the features of the hypertext just before the lesson. A third treatment group used a linear tutorial. The hypertext group with training and practice scored significantly higher on both the immediate and the delayed post-tests.

Lanza and Roselli (1991) compared a linear CAI treatment with a hypertext in computer programming instruction at the college level. Post-test results found no significant advantage for either treatment, though more hypertext subjects found their program "stimulating and attractive." The authors noted that while mean group scores did not differ, the range of scores in the hypertext group was greater than in the linear group.

Harris (1990) compared computer-based linear text and hypertext in college computer literacy instruction. Instruction consisted of a lesson on computer communication lasting about forty-five minutes and followed by a post-test. There were no significant differences in post test scores by treatment.

Achievement results by gender, and the amount of time required to complete the instruction also yielded no significant results.

While the results of these studies do not demonstrate superior achievement results for non-linear hypertext as an alternate delivery system for computer-based lessons, they show that in some circumstances hypertext can be equally, or in some cases more, effective than other systems for delivering textual information to learners. However, the studies reveal no clear pattern of superior time efficiency, post test improvement, or lesson enjoyment, for any one lesson type.

Implications of Hypertext Literature

If the goal is to identify effective uses of hypertext in instruction, these results suggest that it may not be not fruitful to approach hypertext only as an alternate delivery system for factual information in computer-based lessons. Revisiting the characteristics of the medium, one might suppose that hypertext's strength could lie in the representation of conceptual relationships among textual information, and that its use in instruction might best involve modeling or representing those relationships for learners (Jonassen, 1988; Carlson, 1990). While some hypertext systems are being developed according to the principles of cognitive flexibility theory to provide models for use with case-based instruction in complex and ill-structured domains (Spiro, Feltovich, Jacobson, and Coulson, 1991), this approach has not been investigated on a smaller scale within a more clearly structured domain.

Another potentially important issue not addressed in any of the studies is suggested by McGrath (1992, p. 529) in her discussion of results: "Apparently 22-year-old students are simply more accustomed to learning from paper than from computer regardless of degree of learner control. Students will need more practice using the computer for learning." It may be significant that the participants in all four studies were college-age or adult learners. It is possible that the factor of learner age (and its attendant prior experience and mind-set) could significantly affect a learner's approach to and success with a non-linear medium presented via computer.

Norton (1992) in her essay on the computer as discourse, points out that the relationship between the sender of a message, the receiver, and the topic is culturally determined. Observing how today's elementary school age child, born into a world of videocassette recorders and remote controls, uses television might be helpful to those interested in analyzing and researching hypertext. This child may readily browse through his or her favorite tapes, skipping passages and reviewing at will. Television for this child appears much less linear than for passive television watchers. The same child may also be observed spending hours navigating the obscure levels of several video games, searching for strategies which allow non-linear movement among the "worlds" and screens of the games.

Norton might say that the child has acquired a new discourse form not generally practiced by adults; a discourse form probably not anticipated by observers at the time remote controls or video games were first introduced. It might be fruitful to speculate that a similar process may occur with the increasing availability of hypertext. Perhaps children born into a world in which hypertext is common will adopt that discourse form as readily as today's children have adopted video. It has, however, been suggested that younger learners would be distracted by the nonessential information presented and cognitive overhead required in the use of hypertext (Heller, 1990).

Although there has been some investigation of the relationship between children's attitudes toward computers and their attitudes toward video games (Fisher and Pulos, 1983), the potential effects of their video experience on success with computer applications such as hypertext have not been explored. It is possible that these video experiences have encouraged younger learners to develop some skills or attitudes which allow them to work more effectively than today's adults with non-linear hypertext in instructional settings.

Study Design Rationale

Influence of Prior Research

Several characteristics of the design of this exploratory study were influenced by the instructional hypertext studies previously cited. These factors include the age of the subjects, the form of the instruments used to measure knowledge acquisition and retention, and the inclusion of an experience factor in the experimental design.

Testing instructional hypertext with younger subjects appeared to be an obvious extension of the previous studies, all of which were done with young adults. A recently published instructional hypertext study (Shin, Schallert and Saveyne, 1994) has taken this same approach. A further consideration in the decision to work with younger learners was to investigate the potential influence of children's video technology experiences on their use of a non-linear discourse form. Using younger subjects allowed the introduction of video game expertise as an experience factor. In an article published after this study was conducted, Kahn and Landow (1993) have also argued for the importance of considering prior experience as an important factor in learners' success with hypertext.

Post tests employed in previous studies measured retention of factual knowledge, or success in applying the formula modeled in instruction, consisting of various formats of computerized lessons. As Spiro et al. (1991) suggest, presenting items of verbal information or modeling a step-by-step process may not be the most appropriate instructional applications for a non-linear medium like hypertext. Consequently, retention or application of this sort of information may not be the best measure of the effectiveness of the medium. In addition, such measures in previous studies had delivered no clear pattern of results.

For this study, a student activity sheet was chosen, in an attempt to measure, not the retention of facts, but the quantity of information accessed in the process of solving a teacher-assigned problem. It was designed to allow comparison of how effectively students using the linear and non-linear versions of a text accessed and used the required information. The delayed post-test instrument selected was modeled on a graphic organizer (Pehrsson and Robinson, 1985). Its selection and design were influenced by the theoretical discussions of potential relationships between hypertext structures and learners' knowledge structures. It was designed to assess, not only the quantity of factual information retained, but also the effect of a hypertext structure on learners' perceptions of relationships between those facts.

Influence of School Experience

Another major influence on the design of this exploratory study was the author's experience as a media technology specialist at the elementary school level. Observation of elementary school classroom practices, and experiences with computer availability and utilization in elementary schools, influenced decisions about the curriculum content, the instructional role of the hypertext materials, the assessment instruments, and the scheduling of the experimental treatments.

The hypertext treatment in other studies has been a teacher-independent computerized lesson matched with other CAI or paper-based treatments of the same lesson. This type of hypertext application may be unrealistic for public schools, given the limited availability of hardware and the labor-intensive instructional delivery commonly found in the school setting. In an attempt to model common elementary school classroom practice, the hypertext in this study was introduced as one of the several information sources being prescribed as part of teacher-directed instruction.

The content of the hypertext lessons employed in previous studies has consisted primarily of verbal information (psychological terms, computer terminology) and application (using a mathematical formula, introductory word processor operations). The text content used in this study consisted of interconnected facts comprising a body of knowledge. The assigned problem required the student to locate specific factual information from within that body of knowledge and to employ those required facts in a task (worksheet) involving reporting, restructuring, or classifying the information. The design was an attempt to shift, as Spiro et al. (1991) suggest, from an orientation "that emphasizes the retrieval from memory of intact preexisting knowledge to an alternative constructivist stance which stresses the flexible reassembly of preexisting knowledge to adaptively fit the needs of a new situation" (p. 25). This design was also an attempt to employ the hypertext as a supplemental information source supporting a learning task assigned by a teacher as part of classroom instruction. The learners were required to function as "users" and/or "browsers" (Slatin, p. 871) as they worked on teacher-directed tasks which required information contained in the hypertext. The intent of the design was to create a classroom environment in which the hypertext was used as one of several textual tools available to the instructor and the learners as they progressed through a unit or lesson -- a potential instructional role for hypertext which could be a good match to its intrinsic characteristics.

Since in many school settings, access to computer labs is limited, the use of hypertext in computer-based lessons is also likely to be limited. Teachers are more likely to have access to one or two computers within the classroom. The use of hypertext in this study in a supplemental assignment which could be done independently by students throughout the school day, was an attempt to create a design which could study hypertext use in a setting similar to that which might actually exist in many elementary school classrooms.

Materials

Hypertext

The content of the hypertext used in this study, the geological regions of Minnesota and their products, is related to, but does not duplicate, the content of a required fourth grade social studies unit. Prior to the study, the hypertext material was tested with two fourth grade classes in another school. The vocabulary, reading level, and structure of the presentation were judged by fourth grade teachers as being appropriate for that grade level.

In the non-linear version, the hypertext web radiates from numerous graphic choice screens. The content consists of information on each of four geologic regions. The content within each region is organized into four sub-topics: land, products, plants, and the past. Within each sub-topic the content is divided into an information section and an activities section. On entering the non-linear version, the student selects a region from the choice screen. Whenever a region is selected, the four sub-topic choices are then presented for selection. The choice between the information and activities sections is similarly presented on entering each subtopic. The structure provides some guidance for topic selection, in that as each sub-topic on a region is completed, the student is returned to that region's choice screen. However, free access to the entire web is available from every screen through a consistent "quit" button. Pressing this button at any point returns the user to a summary choice screen which graphically displays the four regions and the four sub-topics within each region, with check marks by each which the student has previously selected. A click on any of these icons moves the student directly to that region and topic. This allows students at any point to select screens viewed earlier in the lesson, move on to new information, return to previous choice points, or quit the lesson.

The non-linear hypertext was modified to create a linear version which presents all the screens of the non-linear version, but in a predetermined sequence. In the linear version, the learner has at all times the option of continuing through the pre-determined sequence of screens, reversing the sequence one screen at a time, or quitting. There are no choice screens available, except a warning screen to determine if a student who selects "quit" really wishes to do so.

Both versions were constructed to allow one thirty minute work session per user. When the time expires, the student is forced to quit the lesson. This feature was included to allow comparison of the amount information located and reported on the worksheet by users of linear and non-linear versions within the same amount of work time.

Activity Sheet

The format of the activity sheet completed by students during the thirty minute hypertext session was similar to that of materials used with the required social studies materials. Content of the items was based on the hypertext. Some completion items (e.g. Name the main industry of the Superior Upland area ________.) required locating in the text a single fact and reporting it. Other, more complex items, required locating facts from several areas of the text and combining them in a single answer. For example, a partially labeled Venn diagram (a format familiar to students from previous social studies lessons) required recording some of the farm products of each of two geographic areas, and those which are common to both areas. Several questions made use of graphic maps similar to those located throughout the text to record information found in one or more areas of the text.

The activity sheet was developed by the researcher after reviewing a number of similar sheets used in the fourth grade social studies curriculum. It was then reviewed and revised by several fourth grade teachers who judged the reading level and difficulty of the items as appropriate for fourth grade students. Next it was tested by observing individual fifth grade students complete it using both the linear and non-linear hypertext versions, and by interviewing those students after they had completed it. From these observations and interviews, wording was adjusted to eliminate confusing items, the items were ordered so that information needed for an answer might be found in any part of either hypertext version, and the length of the activity sheet was adjusted to what was estimated to take an efficient student slightly longer than thirty minutes to complete. Finally, a scoring system was developed and tested in conjunction with a pilot run of the study using a smaller (N=51) sample of fourth grade students.

Delayed Post Measure

As mentioned earlier, the post measure was intended to measure retention of factual information, and to assess any affect of the hypertext's structure (linear or non-linear) on the student's awareness of the relationships between those facts. Several possible test formats were considered, including the ordered tree technique (Naveh-Benjamin, et al. 1986), word associations or graphing techniques (Shavelson, 1974), and pattern notes (Jonassen, 1987). None of these seemed appropriate for an exploratory study with elementary school age subjects.

Eventually, a format modeled on a graphic organizer (Pehrsson and Robinson, 1985) was selected as most appropriate for use by this age group in a classroom setting, efficient to administer and score, and offering the possibility of making some inference about the effects of the hypertext structure on students' perceptions of relationships between individual facts. Several designs were then reviewed by the consulting teachers. The one selected was similar in design to the graphic map and choice screens used throughout the hypertext.

A single page displayed the graphic map showing the four regions. Next to each region a large empty rounded rectangle was divided into four sections labeled with the names of the four sub-topics. The directions stated, "On this page, write or draw anything you remember about the regions of Minnesota." Two examples of factual information correctly placed, one a drawing, one written, were included. When the test was administered, the directions were repeated orally three times at intervals, along with encouragement to think back to the hypertext work time and draw or write whatever came to mind. The administration and scoring procedures were developed and tested in conjunction with the cooperating teachers at the time of the pilot run.

Video Game Experience Assessment Instrument

The instrument used to assess video game experience and expertise was developed with the assistance of student volunteers, the cooperating teachers, and several additional pilot classrooms. The first pilot version was constructed by interviewing several highly experienced high school age video game players. It posed numerous factual questions about specific game systems and strategies. However, the wide variety of games and systems available to students made these questions too hard for the panel of elementary school video game student experts who reviewed it. Even these acknowledged sixth grade expert players scored poorly on this initial version. Additional interviews with the younger users led to the development of a second version which combined survey questions about game use (e.g. "If you have any of these game systems at home, circle the ones that you have.) with a few factual questions about the most popular games and systems of the day (e.g. "How many warp zones are there in the game Mario Brothers?"). This version was then tested and discussed individually with several fourth grade students of varying video game expertise.

Finally, a multi-stage classroom testing process was undertaken which involved administering the instrument, interviewing students and teachers, and comparing the scores with teacher ratings and student peer ratings of video game expertise. This process was repeated, with minor revisions to the instrument, in four classrooms in three different schools. In the last of these pilot tests, the instrument achieved a correlation of .7 (N=90) with the peer ratings.

Attitude Survey

The attitude survey was modeled on forms used in previous studies. It contained twelve Likert scale questions designed to measure two issues: lesson enjoyment (e.g. "I would like more lessons like this one."), and lesson organization (e.g. "The computer lesson was confusing."). The sub-scales for these two issues contained six items each. Of these, three were worded positively, and three negatively. Responses were consistently labeled Strongly Agree - Strongly Disagree, and scoring (1-5) was reversed when appropriate to the wording of the question. The six items for each sub-scale were combined and compiled in random order on a single form for the final twelve item test.

The Study

Research Questions and Design

The primary questions addressed by the study were three: Which text structure, linear or non-linear, is used more effectively as a source of information in an assigned problem-solving task? Does the structure of the hypertext, linear or non-linear, affect retention of facts or perception of the relationships between facts? Are frequent users of video game technology more successful than infrequent game users when working with non-linear hypertext? Other questions considered were: With which treatment, linear or non-linear, are participants most satisfied? Do frequent and infrequent video game users vary in their preference for treatment type? Is preference for a particular treatment related to higher scores on the assigned task?

The experiment was of a 2x2 factorial design. The two treatment levels were Linear and Non-linear Hypertext. The two experience factors were High and Low Video Game Experience The three dependent variables were the number of items completed correctly on the activity sheet, number of correctly placed items on the delayed post measure, and the Likert ratings of lesson enjoyment and lesson organization

Participants

The participants were eighty fourth grade students comprising three self contained classrooms in an elementary school in a suburban school district. The study was conducted, with the cooperation of the participating teachers, in the students' regular classrooms during the school day. Parental consent had been obtained, and students were aware of the study. All students were required to complete the materials used in the study as part of their normal social studies requirements.

Procedures

Prior to the study, all participants had completed the assessment of video game experience form. These were scored and a median split was used to assign the participants to two groups of equal size: High Video Game Experience and Low Video Game Experience.

Equal numbers of participants within the High and Low Game Experience groups were then randomly assigned to the linear and non-linear treatments. Participants were not informed of their group or treatment assignments. They were told that they were trying out some new computer software which other schools might someday use. Following identical procedures, both treatments were delivered concurrently using Macintosh computers located in the classrooms. The use of the Macintosh and mouse was demonstrated briefly for the whole class during their social studies period, then each participant was given a sealed packet containing a disk and activity sheet. Participants each completed the treatment individually, under classroom teacher supervision, during the next three school days.

While using the hypertext at the computer, each student completed the activity sheet.

As each student's thirty minute work time elapsed, activity sheets and disks were collected and the student completed the attitude survey which was also collected. Several days after the lesson was completed, the delayed post measure was administered by the researcher during the class social studies period. After all data had been gathered, a debriefing session was held in each classroom and results were shared with the students and teachers.

Results

Worksheet Scores, Post-Lesson Scores, and Attitudes

Each of the three dependent measures was subjected to separate two way ANOVA's with Video Game Experience and Treatment as independent variables. No significant main effects or interactions were found for any of the dependent variables.

Exploratory Analysis

A post hoc analysis of the data for each dependent variable was completed using a three way ANOVA with Gender as the added independent variable. A significant main effect was found for Gender $F(1,72) = 4.0$, $p<.05$ on the Likert scale attitude score for lesson organization. Males (mean = 3.42) rated the lesson organization as clearer and more easy to follow than did females (mean = 2.91).

Discussion

The study explored several potential extensions to the experimental designs previously used in studies comparing linear and non-linear hypertext: (a) younger subjects, (b) grouping by video game experience, (c) assigned instructional activity rather than computerized lesson, (d) worksheet rather than achievement test, (e) stand-alone classroom computer for lesson delivery rather than mass computer lab, (f) recall post-measure rather than delayed post-test. While the study did not find a significant effect for any one of these factors, the experience gained with these extensions may assist in the design of future studies in this emerging area.

That fourth grade students using both the linear and non-linear versions successfully completed the activity sheet supports the assertion that lesson-length hypertexts can be used effectively by learners at this level. This finding is supported by the recently published Shin, Schallert, and Saveyne study (1994). Student attitudes toward both lesson versions remained moderately positive (1-5 Likert scale, mean = 3.475) after completing them. In addition, the experimenter observed that most subjects appeared to approach the lesson with enthusiasm. These results appear to justify further investigation of hypertext applications at the elementary school level.

That the video game experience factor did not yield significant results may be an indication that the two media, video games and hypertext, are too dissimilar for skills or attitudes to transfer between them. It is possible as well to question the validity of the instrument used in this study to measure video game experience. Information gained in the process of development showed it to be difficult to assess a general level of "video game experience" beyond expertise with individual games or game systems. Further investigation of the influence of experience factors on hypertext use has been suggested by the results of other studies (Lin, 1991; Kahn and Landow, 1993). Since the selection of video game technology as the experience factor for this study was somewhat arbitrary, the effects of experience with other video or microcomputer applications on hypertext use might be investigated in future studies.

The participating teachers indicated that the employment of the hypertext as an assigned activity supplementary to classroom teacher-directed instruction was appropriate to this particular curriculum area and to their general classroom practices. One potentially confounding factor with this approach is the possibility that variation among teachers in the implementation of the curriculum content related to that presented in the hypertext might affect students' performance in the experimental activity. Future studies may want to control for this potential influence, perhaps by using a pre-test to determine prior content knowledge. Another possible approach would be to use hypertext whose content had previously been introduced to all subjects via uniform readings or a video presentation. The hypertext activity would then be used in a role similar to that suggested by some researchers for instructional simulations (Thomas and Hooper, 1991; Thurman, 1993), to encourage transfer and application rather than acquisition of new knowledge.

The activity sheet, when used in the experimental setting, appeared to be more difficult to complete than the development and pilot results had indicated. It is possible that the length and difficulty of the activity (24 items, mean = 10.38) may have caused some subjects to abandon the task prematurely. Attempting to keep the lesson content appropriate to the subjects' age, resulted in a relatively short (30 minute) treatment time. A treatment of this duration may not have been sufficient to elicit measurable differences in treatment effect, an issue raised recently by Reeves (1993) and relevant as well to some of the previously cited instructional hypertext studies. Future studies might employ treatments of longer duration.

Delivering the experimental treatment throughout the school day via individual computers located in the classroom offered both advantages and disadvantages. The configuration and schedule appeared to be accepted by students and teachers as conforming with routine classroom practice. The experimental procedures appeared to run smoothly as part of the classroom routine, providing a seemingly uniform and non-threatening experience for students regardless of treatment, classroom, or group assignment.

On the other hand, subjects experienced the experimental treatments over the course of three school days. Ongoing activities within the classroom and the school during this time may have resulted in unequal experimental conditions for some subjects. One student, for example, may have worked as the only student in the classroom, while another may have worked at the computer while potentially distracting class activities went on nearby. Choosing between the authenticity of the classroom setting and the more controlled, but perhaps more artificial, computer lab setting is difficult. Perhaps using small groups of classroom-based computers, thus allowing the treatment to be delivered during one class period over several days, or during one full school day, might provide a satisfactory compromise.

The relatively low activity sheet scores and lack of detailed information about subjects' prior knowledge, made interpretation of post-measure scores difficult. In the future, this measure could be paired with a more typical post-test, or compared with a broader test of prior knowledge. The approach attempted by this post measure is congruent with that of some hypertext studies published since its design (Jonassen and Grabinger, 1993; Jonassen and Wang, 1993). Such studies might provide guidance for designing more sensitive instruments for measuring levels of structural knowledge acquisition and retention.

Since none of the previous hypertext studies had found any achievement or attitude differences based on gender, the gender difference in attitude toward lesson organization found in this study was unexpected. This finding is not surprising, however, considering that girls have been shown to use computers less outside of school, and are more likely than boys to self-select out of computing activities in school (Gilliland, 1990). The significant difference in attitude found here, coupled with no difference in achievement by gender, might merit further investigation in light of issues raised about innate vs. socialized gender differences related to information technology (Kirk, 1992).

It might be fruitful, as well, to investigate how interactions between experience level and gender might influence students' attitudes toward a hypertext lesson. Canada and Brusca (1991) report that gender-based attitude differences toward technology disappear when males and females have equal amounts of technology experience. While this study did not find significant attitude differences by experience level, membership in the High Video Game Experience Group was two-thirds male (24 of 36 members were male), and the Low Experience Group two-thirds female (25 of 44 members were female). Future studies might measure experience with various technologies by gender for comparison with attitude scores. Another approach could be to investigate the nature of the attitude differences in greater detail, perhaps employing an interview or other more sensitive measure of attitude.

Conclusions

Although knowledge acquisition or retention benefits have not been demonstrated for the small-scale hypertext employed in this study, it is clear that this type of hypertext can be used by elementary school students. This finding justifies further investigation of effective instructional uses for hypertext at this level. The attempt in this study to create an authentic classroom setting, instructional task, and measure of student success, may provide inspiration or guidance for the design of future studies in this area.

If there are learner characteristics which influence success with hypertext, they remain to be identified. The exploratory analysis done here suggests that influences of gender on attitude and performance in this area might be investigated further.

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Title:

Tracking Teachers' Personal Variables and Computer Use: Phase Two*

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Introduction

Teachers underutilize computer technology in teaching. At the same time, there is much support for the use of computers in education. Strong evidence for this is the increasing number of computers available per student—the microintensity level. The national average has improved to 18 students per computer as of 1992 (Market Data Retrieveal). Yet, teachers have not overwhelmingly adopted computer technology for teaching. According to a national surevy, only one teacher per school, on average, integrates computer technology into his or her teaching (Sheingold & Hadley, 1990).

Questions

This apparent discrepancy between teachers' use of computers and others' expectations of teachers' use of computers broached several questions focusing on the developmental history of teachers beginning with their undergraduate training.

1. At what levels do student-teachers expect to use computers during professional teaching?
2. At what levels does the same population actually use computers after having taught professionally for one year?
3. Do any personal variables predict levels of use during either condition?

Method

A longitudinal study of teachers' computer use and personal variables which might predict that use was undertaken. The study was begun with a group of undergraduate elementary majors during their penultimate year of study and was repeated three years later after the same participants had graduated and worked as teachers professionally for one year.

Participants responded in writing to questionnaires that included several measures. Similar formats were used in both phases with the exception that for the first phase the participants were instructed to respond to the questionnaires based on their expectations while during the second phase they were instructed to respond based on their actual experience. Also, during the second phase, the questionnaires were mailed to the participants rather than the questionnaires being administered simultaneously in a classroom. Upon the first mailing, the number of respondents was poor. A follow up of telephone calls to all original participants greatly increased the number of responses.

Participants

During the first phase, 167 preservice undergraduate elementary education majors participated (Marcinkiewicz & Grabowski, 1992). During the second phase, 100 of the original participants participated. Attrition was due to untraceable change of address, failure to respond, or change of profession.

Variables

The criterion variable was levels of computer use. The personal variables were innovativeness, self-competence in using computers for teaching, perceived relevance of computers for teaching, and teacher locus of control. Demographic data for age, years of computer experience, and gender were also collected.

Instruments

The instruments used included the following:

1. Levels of Computer Use (Marcinkiewicz & Welliver, 1993) scale based on the model of Instructional Transformation (Rieber & Welliver, 1989).
2. The Innovativeness Scale (Hurt, H. T., Joseph, K., & Cook, C. D., 1977).
3. Self-competence in computer use for teaching measures were developed for the study.
4. Perceived relevance of computer use to teaching measures were developed for the study.
5. Teacher Locus of Control Scale (Rose, J. S., & Medway, F. J., 1981, 1982).

Analyses and Results

Results of the LCU scale were compared, logistic regression was calculate to identify predictors of levels of computer use.

a. Phase 1 data analysis revealed 97% expected to use computers in teaching and only 2.7% did not expect to use computers at all.
b. Phase 2 revealed 61% actually used computers and 39% did not use computers at all for teaching.
c Self-competence and perceived relevance predicted computer use in the first phase but not the second.
d. The correlation between perceived relevance and self-competence nearly doubled between phases.
e. Locus of control from the first phase predicted computer use in the second, c2 (1, $n = 150$) = 4.5, $p < .03$.
f. Phase 2 actual computer use data were lower than Phase 1 expectations but were somewhat better than that of an unrelated group (N= 170).of practicing teachers (Marcinkiewicz, 1993). See Table 1.

Table 1:

Computer Use: Phase 1 vs. Phase 2 vs.Other Practicing Teachers'

Levels of Computer Use	Phase 1 Expectations	Phase 2 Actual	Other Practicing Teachers' Actual
Nonuse	2.7	39	43
Utilization	84	60	49
Integration	13.3	1	8

Discussion

Overall the participants' actual computer use was lower that the ir undergraduate expectations, but somewhat better than that of an urelated comparison group of practicing teachers. The differences between the expected and actual use invite several explanations. The levels for actual use could have been a regression to the mean, on the other hand, when the levels of actual use were compared with actual levels of the unrelated group the former did better. They a significantly higher percentage of computer users and a lower percentage of computer non-users. The high expectations of computer use during the initial phase could be attributable to a the universtiy teacher training program While no personal variables were sustained as contributors, the increase in correlation between perceived relevance and self-competence in the use of computers for teaching suggests their collinearity. The identification of teacher locus of control from phase 1 as a predictor of computer use during phase 2 may have practical application in guiding student teachers towards integrating educational computing.

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Title:

Closed-Captioned Prompt Rates: Their Influence on Reading Outcomes

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Abstract

The high school graduation rate will increase to 90%, and every adult American will be literate and possess the knowledge and skills necessary to compete in a global economy are two of six national education goals advocated in "America 2000." At this time the majority of high school drop-outs are considered seriously deficient in reading, English, mathematics, and other functional skills. Consequently, our nation's competitiveness in the global economy is weakened and the burden of social welfare programs has been increasing. The earlier reading improvements can be accomplished, the better the chance to increase high school graduation rates.

This study addresses regulating closed-captioned videotape prompt rates as a technological approach to improve reading comprehension/retention skills in "at risk" elementary school students. It is a within factor experimental design which examines retention of learning from closed-captioned videotape with regulated prompt rates. Two groups comprised of 158 fourth, fifth, and sixth grade reading deficient students (i.e., Chapter 1 and mildly disabled) participated in a Pilot Study (18 students) and Experimental Study (140 students). Students were randomly assigned to either an Average-Paced Closed-Captioned Video, a Slow-Paced Closed-Captioned Video, or printed text (no video), which served as a control measure.

Results indicate significantly more learning occurs for those students using captioned video compared to those having traditional print materials. Additionally, students assigned to the Slow-Paced Prompt Rate retained significantly more information than those having the Average-Paced captioned video.

These results suggest educators can better help their reading deficient students by choosing captioned video curriculum other than traditional print materials. Results also suggest that video producers should take into consideration the prompt rate of their captioned video materials and implement captioned prompt rates that are appropriately paced for use in inclusive classroom environments.

Introduction

Title 1/Chapter 1 of the Elementary and Secondary Education Act (ESEA), enacted in 1965, and PL 94-142, enacted in 1975, have been the driving forces providing extra instruction in compensatory programs in reading, writing, and mathematics to millions of disadvantaged, "at risk" children, and mildly disabled children. For both programs, there is little consistency within and between states as to method of instruction, materials, and mode of evaluation (LeTendre, 1991; Johnson, 1987). As early as 1979 Drum and Calfee reported reading compensatory programs resembled "regular" reading instruction and suggested the programs only added **amount** of instruction without changing the **manner** of instruction. LeTendre (1991) comments that most Chapter 1 reading programs still rely on traditional practices (i.e., ditto sheets, questions at the end of chapters, etc.).

Despite these efforts, compensatory reading programs are not highly successful in bringing students to reading levels of their more advantaged peers. In an extensive U. S. Department of Education study, the report concluded that "students receiving Chapter 1 services experience larger increases in their standardized achievement test scores than comparable students who do not. However, their gains do not move them substantially toward the achievement levels of more advantaged students" (cited in Fagan & Heid, 1991). The level of reading improvement for mildly disabled students is equally dismal (Levine, 1987). They never catch-up with their nondisabled peers. Chapter 1 and reading programs provided for mildly disabled students are closely related in that both programs are presently under close scrutiny for accountability for student performance. It is estimated the majority of students who drop out of school have severe reading deficits, despite receiving Chapter 1 or services in reading for learning disabilities (LeTendre, 1991; Johnson, 1987).

The reauthorization of Chapter 1 by the Hawkins-Stafford School Improvement Amendments of 1988 (U.S. House of Representatives Committee on Education and Labor) mandates accountability for reading improvements; the new "transition" amendment to Individuals with Disabilities Act (IDEA) essentially raises the same issues (Sherman & Sherman, 1989). Latest figures suggest approximately 51% of mildly disabled young adults are without employment after receiving intensive special educational services as students. The majority of these adults are poor readers (Behrmann, 1992).

Clearly there is encouragement for educators to explore new methods and materials that increase student performance while stressing high order thinking (Hofmeister, 1992). Chapter 1 and IDEA can play an important role in the pursuit of two of our national education goals: to make sure that by year 2000 (1) the high school graduation rate will increase to 90%, and (2) every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship (Bush, 1991).

Use of closed-captioned educational video can be a promising technological method to accomplish Education 2000 goals. Recent results of a study using closed-captioned video with college level students having reading deficits suggest closed-captioned video may be an effective method. Preliminary results suggest students without reading deficits learn and retain information more efficiently after viewing closed-captioned educational video than without closed-captioning; however, this proved to be the least effective for those students with reading deficits (Meyer & Lee, 1992). These effects may be the result of the prompt rate, which is matched with the speed of the narration. Poor readers may not be able to keep up with the rate; therefore, the captioning may be frustrating and distracting to the reading-deficient student. Therefore, there is a need to examine the effect of the prompt rate of closed-captioned educational video to better understand how it affects the reading comprehension of Chapter 1 and learning disabled students.

As reported in the National Captioning Institute Newsletter (August, 1990), former First Lady Barbara Bush, who made literacy one of her personal projects, voiced support for using captioning as an educational tool. Following a demonstration of closed-captioned technology at a White House meeting, Mrs. Bush commented, "It is so exciting to learn about research that indicates captioned television can help adults and children improve their reading skills, both at home and in a classroom." Mrs. Bush was commenting how closed-captioned video helps Asians and Hispanic-Americans learn English. This research explores whether these same kinds of gains can be made with persons who have significant reading deficits, but have English as their native language. If they respond to this technological tool, there is great potential to use closed-captioned video throughout American school systems, from elementary school through adult education.

Much of the current research with closed-captioned video has been done with Hearing Impaired (HI) populations (Montandon, 1982; Sherman & Sherman, 1989) and with persons who use English as a Second Language (ESL) (Markham, 1989; Spanos & Smith, 1990). Results are encouraging that closed-captioning is effective in enhancing learning. At this time, however, little has been done investigating whether reading deficient students being served in compensatory reading programs can learn more efficiently using closed-captioned video media with prompt rates correlated to their comprehension reading rates.

This study investigates whether reading deficient Chapter 1 and mildly disabled students (i.e., those with learning disabilities and/or behavioral disorders) learn and retain information more efficiently using closed-captioned video with appropriate paced prompt rates. Positive results using captioning technology should spark a new "industry" in the tailoring of closed-captioned videotaped educational media for learners of all abilities, including those with various reading deficits.

The first direct result of this research should affect methods and materials in the nation's Chapter 1 programs and those designed for mildly disabled reading students, including those served in inclusion models. Positive results from this study will support future directions to ensure accountability for optimal learning for Chapter 1 and learning disabled reading students. Development and use of more appropriate closed-captioned video across disciplines will better ensure success for all students and enhance the probability of improved high school retention/graduation rates as well as increased literacy skills in America.

Method

The purpose of this study is to examine closed-captioned prompt rates and their effect on learning for elementary students who underachieve in reading.

Subjects

Seventy-eight. fourth, fifth, and sixth grade students in Chapter 1 reading and sixty-two students with learning disabilities (52 students) and/or behavioral disorders (10 students) participated in this study. All students met state requirements for services in reading. Criteria for selected students were program placement, reading composite scores from the Iowa Test of Basic Skills (ITBS), and Reading Rate and Accuracy Level tests (Carver, 1987a, 1987b, 1992a, 1992b). The ITBS reading composite grade equivalency mean score was 3.64 (SD 1.03). Carver Reading Rate words per minute mean score for selected students was 116.49 (SD 25.36). Accuracy Level mean score for selected students was 21.68 (SD 6.02), with a mean grade equivalency of 3.23 (SD .97).

Table 1: Demographic Composition

Group	Age in Months		Gender		Race		
	Mean	Std. D.	Male	Female	White	Black	Other
MD	135.89	(16.13)	42	20	49	12	1
CH-1	135.32	(12.29)	31	47	33	45	0
Total	135.57	(14.07)	73	67	82	57	1

Materials

A 10 minute edited educational video, "The Truth About Turtles (Stouffer, 1990)" was used as treatment material. The script was modified to match the editing. The video's narration was replaced with background music; therefore, students had to read the captioned text with no auditory narration. The script was captioned and matched to the visual image. Two treatment videos were produced: Average-Paced Prompt Rate and Slow-Paced Prompt Rate.

Measures

A 13-item multiple choice test was constructed to measure students' knowledge of the topic and the content of the video. The items were constructed to test subjects' ability in decoding single words, understanding vocabulary, interpretation of sentences (including appreciation of morphology and syntax), identifying main ideas, identifying supporting details, rejecting irrelevant or distracting information, retelling a passage, identifying the author's intention and/or point of view, and summarizing. These are considered relevant parameters of reading comprehension necessary for reading success (Levine, 1987). This paper and pencil pretest was read to the students in small groups. Any student who scored 70% or better was to be eliminated from the study. No student scored that high. This test served as the pretest, posttest, and retention test measure.

Design

The experimental design is a 2x3x3 (Group x Treatment x Test Scores) within factor design. The two groups of students are Chapter 1 reading students and mildly disabled students with reading deficits. The three measures are pretest, posttest and retention test. The three treatments and their descriptions are:

A	Average-Paced Closed-Captioned Video. Students receiving this treatment viewed a closed-captioned video with prompt rate set at the mean reading rate of 116 words per minute.
S	Slow-Paced Close-Captioned Video. Students receiving this treatment viewed a closed-captioned video with prompt rate set at the mean reading rate of 78 words per minute.
P	Printed Media. Students receiving this treatment read a printed text in the amount of time allowed for the closed-captioned video. (This treatment served as control.)

Based on the grouping and treatment assignment described above, a grouping chart is depicted as follows:

Table 2: Design Chart and Cell Size

		Caption Prompt Rate		Printed
		Average-Paced	Slow-Paced	
Group	MD	21	19	22
	CH-1	26	20	32

Experimental Questions

1. Between groups, do Chapter 1 reading students perform differently from mildly disabled reading students in terms of their Carver reading comprehension rate and accuracy scores.
2. Between groups, do Chapter 1 reading students perform differently from mildly disabled reading students in terms of their mean pretest, posttest and retention test scores?
3. Between groups, do Chapter 1 reading students and mildly disabled reading students receiving the same treatment perform differently in their mean posttest and retention test scores?
4. Within groups, are there differences among treatments in mean posttest and retention test scores?
5. Are there differences between the experimental treatment (captioned video) and control (print) in mean posttest and retention test scores?
6. Are there differences between Average-Paced and Slow-Paced Prompt Rate treatments in mean posttest and retention test scores?

Apparatus

Production equipment used for this study were: 2 NEC PC-VCRs, a Softtouch closed-captioned encoding interface card, a DE132 decoder card, a Timebased video signal corrector, and a captioning software package, CPC 7000, installed on an IBM compatible personal computer to serve as a closed-captioned encoding station. Equipment used for data collection were 3 AV carts each housing a TeleCaption 4000 closed-captioned decoder, a Sharp 25" color video monitors, and an RCA 4-head video cassette player.

Procedures

Reading rate and accuracy reading level for nondisabled fourth, fifth, and sixth graders were 147 words per minute, or 4.4 grade level equivalency (Carver, 1987a, 1987b, 1992a, 1992b). These reading scores were established through standardized tests using only printed materials. This study used materials demanding attention to audio and visual movement as well as printed text (i.e., captioning). Other captioned videos designated for use in elementary classrooms were viewed and measured. Rates ranged from approximately 110 to 130 words per minute. Therefore, the captioned prompt rate was set at 116 words per minute as suggested by the Carver data. During the Pilot Study, a questionnaire was given the students asking for their responses concerning their comfort level with the prompt rate. Students indicated it was too fast. Therefore, we decided to use the prompt rate of 116 words per minute as the Average-Paced Prompt Rate that would be appropriate for nondisabled readers. (This rate also corresponded with other commercially produced captioned videos designed for elementary classrooms.)

The Slow-Paced Prompt Rate was determined by finding the lowest Accuracy Level Score and Reading Rate Score from the subject pool. According to Carver's Rauding Rate Score table, the appropriate words per minute level would be approximately 2 grade levels below the 116 words per minute average. This suggested a Slow-Paced Prompt Rate of 78 words per minute.

Pilot Study: Eighteen students drawn from the subject pool (i.e., 9 Chapter 1; 9 mildly disabled reading) were used in a Pilot Study. The Pilot Study consisted of 3 students per cell for both groups. Results from this Pilot Study were used to adjust the experimental process.

Experimental Study: One-hundred and forty students who scored below 70% correct in the pretest were randomly assigned to one of the three treatments. One week after the students completed the pretest and met the requirements, they were randomly assigned to one of the three treatments. Data of posttest scores were collected immediately after treatment; retention test scores were collected two weeks after treatment. Test items were read to the students for all measures.

Results

The dependent variables for the study were mean pretest, posttest, and retention test scores. Test items of the pretest, posttest and retention test were constructed in a multiple choice format.

Based on the experimental questions, all data were analyzed using the following statistical analysis procedures with a significance level set at a = .05. Trends are also reported with a significance level of < .10. Statistical analyses of all data in this investigation were performed through the use of SAS statistical software.

Analysis of Variance (ANOVA) procedures were conducted for all measures. When a significant difference was found in pretest scores, difference scores rather than mean scores were used for posttest and retention test analysis.

Mean scores of students' performances on pretest, posttest, and retention test are listed in Table 3. Difference scores are included in text.

Table 3: Mean Scores of Three Measures

Group		Pretest	Posttest	Retention
Sample (N = 140)	Mean	3.69	6.30	5.34
	Std. Dev.	(1.69)	(2.40)	(2.20)
MD (n = 62)	Mean	4.02	6.75	5.79
	Std. Dev.	(1.84)	(2.62)	(2.47)
CH-1 (n = 78)	Mean	3.43	5.95	4.97
	Std. Dev.	(1.52)	(2.16)	(1.89)
Average-Paced (n=47)	Mean	3.89	6.74	5.74
	Std. Dev.	(1.81)	(2.21)	(1.89)
Slow-Paced (n = 39)	Mean	4.37	7.62	6.54
	Std. Dev.	(1.73)	(2.10)	(1.82)
Control-Print (n=54)	Mean	3.04	4.98	4.13
	Std. Dev.	(1.30)	(2.11)	(2.12)
MD/Average (n = 21)	Mean	4.33	7.05*	6.05
	Std. Dev.	(1.83)	(2.63)	(1.91)
MD/Slow (n = 19)	Mean	4.74	8.05	7.05
	Std. Dev.	(1.97)	(2.37)	(2.17)
MD/Print (n = 22)	Mean	3.09	5.36	4.45
	Std. Dev.	(1.38)	(2.22)	(2.61)
CH-1/Average (n=26)	Mean	3.54	6.50	5.48*
	Std. Dev.	(1.75)	(1.84)	(1.87)
CH-1/Slow (n = 20)	Mean	4.00*	7.20	6.05
	Std. Dev.	(1.41)	(1.77)	(1.28)
CH-1/Print (n = 32)	Mean	3.00	4.72	3.91
	Std. Dev.	(1.27)	(2.04)	(1.71)

* denotes one missing data.

Between Group Effects

Question #1: A multivariate analysis was performed. No group differences were found for the Carver reading rate and accuracy measures. Both Chapter 1 and mildly disabled students were equivalent in their reading skills.

Question #2: Analysis for group differences produced a significant effect on pretest test scores $\underline{F}(1,138) = 4.25$, $\underline{p} = .0410$. The mildly disabled students ($\underline{M} = 4.02$, $\underline{SD} = 1.84$) outperformed their Chapter 1 peers ($\underline{M} = 3.43$, $\underline{SD} = 1.52$) in their previously acquired knowledge about turtles.

No group differences were found for posttest and retention test measures. Chapter 1 and mildly disabled students performed equally for all treatments.

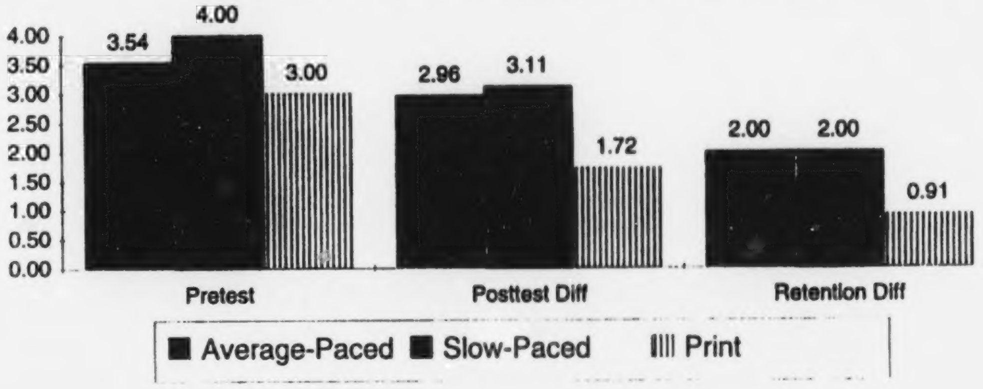
Question #3: No group differences were found in posttest and retention test for all treatments. Both groups learned similar amounts of information.

Within Group Effects

Question #4: For mildly disabled students, the pretest measure was significant F(2, 61) = 5.16, p = .0086. Mildly disabled students assigned to both Prompt Rates (Average-Paced Prompt Rate M = 4.33, SD = 1.83; Slow-Paced Prompt Rate M = 4.74, SD = 1.97) had more previous knowledge about turtles than their peers (M = 3.09, SD = 1.38) in print media. No difference was found for both posttest and retention test measures.

For Chapter 1 students, a trend was found F(2, 77) = 2.82, p = .0658 for pretest. Chapter 1 students assigned to both Prompt Rates (Average-Paced Prompt Rate M = 3.54, SD = 1.75; Slow-Paced Prompt Rate M = 4.00, SD = 1.41) tended to know more information about turtles before treatment than their same-group peers in the control group (M = 3.0, SD = 1.27) using print media. A significant difference was found for posttest F(2, 76) = 4.09, p = .0206. Chapter 1 students assigned to the captioned video treatments (Average-Paced Prompt Rate Difference M = 2.96, SD = 1.82; Slow-Paced Prompt Rate Difference M = 3.11, SD = 1.41) scored higher than their within-group peers (Difference M = 1.72, SD = 2.34) who received print media. A significant difference was found for retention test F(2, 75) = 3.28, p = .0433. Chapter 1 students assigned to the captioned video treatments (Average-Paced Prompt Rate Difference M = 2.00, SD = 1.78; Slow-Paced Prompt Rate Difference M = 2.00, SD = 1.63) scored higher than their peers (Difference M = .91, SD = 1.99) who received print media.

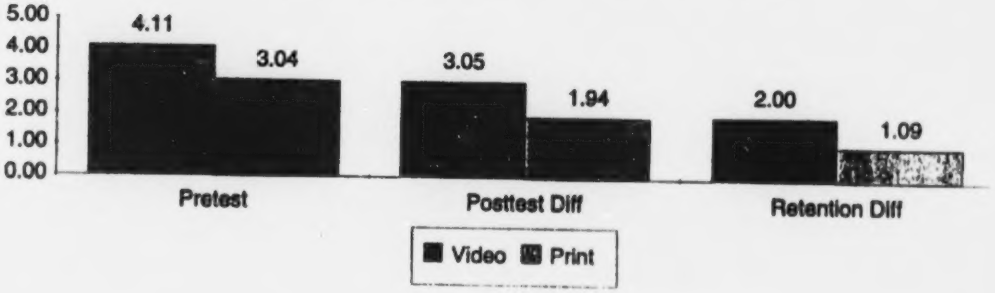
Figure 1: Chapter 1 Within-Group Differences



Treatment Effects

Question #5: For Experimental students, a significant difference was found F(1, 138) = 14.52, p = .0002 for pretest. Experimental students assigned to both Prompt Rates (Combined Prompt Rate M = 4.11, SD = 1.78) knew more information about turtles before treatment than their peers in the control group (M = 3.04, SD = 1.30) using print media. Treatment differences were found in both posttest and retention test scores. There was a significant difference in posttest scores F(1,137) = 8.79, p = .0036. Students assigned to the captioned video treatments (Difference Prompt Rate M = 3.05, SD = 2.05) learned more information than students assigned to print media. (Difference M = 1.94, SD = 2.26). There was a significant difference in retention test scores F(1,137) = 6.54, p = .0116. Students assigned to the captioned video treatments (Difference Prompt Rate M = 2.00, SD = 1.84) retained more information than students assigned to print media. (Difference M = 1.09, SD = 2.30). Figure 2 illustrates differences between combined treatments and control

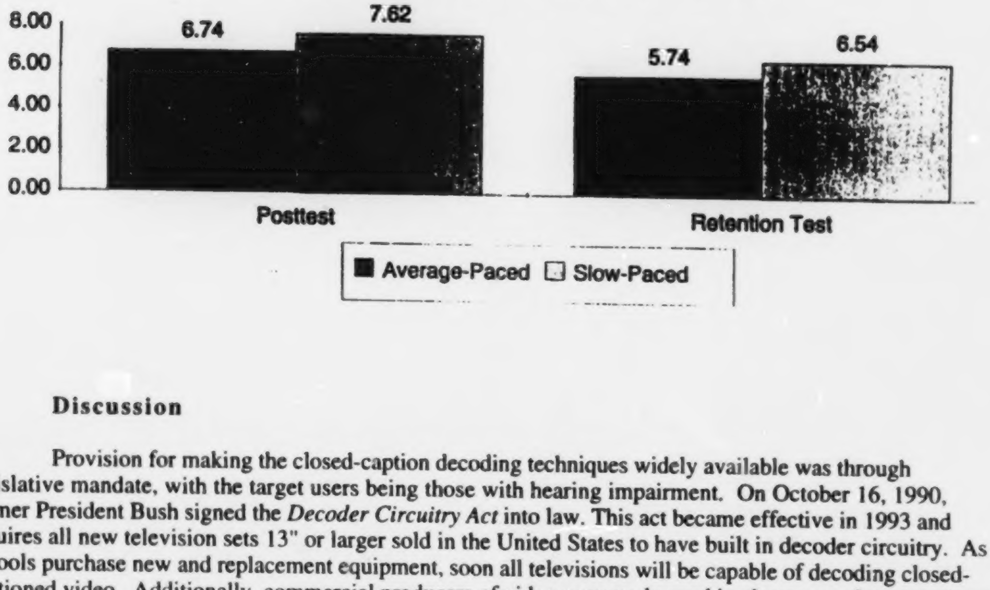
Figure 2: Experimental vs. Control—Difference Means



Question #6: No difference in experimental groups was found in pretest. Therefore, an ANOVA was used for analyses of mean scores.

A trend was found in posttest F(1, 84) = 3.48, p = .0655. Students assigned to the Slow-Paced Prompt Rate treatment (M = 7.62, SD = 2.10) tended to do better than those assigned to the Average-Paced Prompt Rate treatment (M = 6.74, SD = 2.21). There was a significant difference in retention test scores F(1, 84) = 3.91, p = .0514. Students assigned to the Slow-Paced Prompt Rate treatments (M = 6.54, SD = 1.82) retained more information than students assigned to the Average-Paced Prompt Rate treatment (M = 5.74, SD = 1.89). Figure 3 illustrates differences between the two experimental treatments.

Figure 3: Caption Treatment Effects



Discussion

Provision for making the closed-caption decoding techniques widely available was through legislative mandate, with the target users being those with hearing impairment. On October 16, 1990, former President Bush signed the *Decoder Circuitry Act* into law. This act became effective in 1993 and requires all new television sets 13" or larger sold in the United States to have built in decoder circuitry. As schools purchase new and replacement equipment, soon all televisions will be capable of decoding closed-captioned video. Additionally, commercial producers of video commonly used in classrooms for educational purposes are in the process of captioning all their new offerings and file videotapes. Many offer to exchange any videotapes owned by schools without captioning for ones with captioning.

Inclusive educational environments are the norm in most states. This model includes children with disabilities in the regular classroom with their peers. Special services are delivered by the teacher and support personnel in the regular classroom. Therefore, there will be children with a wide range of abilities in each classroom. Curriculum materials must be flexible in order to maximize learning for these differences.

Results from this study support that reading problems of children with mild disabilities, the majority being learning disabled, and those in Chapter 1, are similar. Their reading rates and accuracy reading levels are equivalent. However, children who are classified as mildly disabled (i.e., learning disabled and/or behavior disordered) under the rules and regulations of IDEA receive much more intensive remediation and one-to-one attention for their deficits than children in Chapter 1 classes. This could account for students with mild disabilities knowing more information about turtles than their Chapter 1 peers before treatment. Mildly disabled children are provided with more educational experiences delivered through hands-on materials and manipulatives. After both groups received the information about turtles, the differences disappeared. Chapter 1 students learned and retained more information about turtles than their mildly disabled peers. They caught up.

Chapter 1 students improved their knowledge base about turtles significantly more than mildly disabled students after seeing the captioned video treatments. They might have found the captioned video more novel and, therefore, paid more attention to the video content. The more traditional print materials were not as stimulating and produced significantly less learning and retention of information. It is interesting to note that the mildly disabled students did not show a significant difference in their learning when using print materials. The emphasis on learning strategies in their educational programs may have caused this, although their scores for captioned treatments were higher, but not significantly so.

There is controversy among teachers whether children are saturated with videos in the classroom to the point they no longer pay attention to content. Results support this is not the case. When students experienced a moving visual, music, and print at the bottom of the screen, they attended to the information presented. All children with reading deficits learned and retained more though captioned video, even when there was no narration to give them additional clues to its content.

The critical question in the study was the examination of the power of the prompt rate. Did its speed make a difference for children who struggle in reading? A strong trend indicated that the Slow-Paced Prompt Rate was better for these children when assessing learning immediately after treatment, but would this learned information still be there two weeks later? The retention test is the more powerful measure of learning and what teachers strive for with their students. Yes. Slow-Paced Prompt Rate was significantly better than the faster Average-Pace Prompt Rate. Students with reading deficits responded positively when they had more time to process the captioning vocabulary.

Results of this study are important for teachers, parents, and commercial producers of videotapes. Children will learn and retain more from captioned educational videotapes rather than traditional print materials containing the same information (e.g., books, workbooks, ditto pages, etc.). Additionally, educators should address reading deficits in Chapter 1 and mildly disabled special education students similarly. Chapter 1 students appear to respond strongly to novel curriculum approaches which supports Drum and Calfee's (1979) assertion these students have been given much more of the "same old stuff." When teachers have the option of using a television with a captioning decoder chip along with a closed-captioned video, they should use it in their classrooms for all subjects.

Parents search for ways to help their children improve their reading skills. Using the captioning option on their home television for closed-captioned programs is an easy, inexpensive way to help their children. Each month more programs are closed-captioned and are designated by a closed-captioned symbol in television guides. A growing body of research suggests captioning, intended for hearing impaired populations, is highly effective for learning language and improving literacy skills.

Companies which are in the process of captioning their educational videotapes should take into consideration the many viable uses of captioning in education. Prompt rates should be designed so that children with various reading speeds and comprehension skills have enough time to read and process the information. Until technology is developed that allows users to adjust prompt rates to their own reading rate level, captioned video materials must take into consideration a variety of reading competencies.

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Title:

Experiences With An Off-Campus Agriculture Degree Program: The Graduate Perspective

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Introduction

Off-campus degree programs are becoming more common as universities recognize the need to extend educational opportunities beyond the campus to adults who are unable to pursue degrees through traditional means. Off-campus degree programs fit well within the mission of land-grant university colleges of agriculture. The College of Agriculture at Iowa State University recognized the importance of extending degree programs to distant learners, and began offering an off-campus master of agriculture degree in 1979. The off-campus program expanded to include a bachelor of science degree in 1991. The purpose of the off-campus agriculture degree programs is to provide post-secondary agricultural education opportunities to persons who are unable to or prefer not to study on campus (Miller & Honeyman, 1993).

Off-campus students are significantly different from traditional college students. Distant learners are typically older and generally maintain a professional career in addition to taking courses (Wilson, 1991). Miller and Honeyman (1993) described off-campus learners enrolled in selected agricultural videotaped courses as being older, generally farmers or agricultural professionals, and motivated to enroll in the program to pursue a degree. Lehtola and Boyd (1992) described agricultural distant learners as self-motivated and self-disciplined while Gulliver and Wright (1989) noted that distant learners did not place a high degree of value on interacting with other students. The unique characteristics of agricultural distant learners may interact with program variables to create unintended obstacles to off-campus study. Therefore, faculty, staff, and administrators involved with off-campus programs must understand and make accommodations for the unique characteristics and preferences of agricultural distant learners.

Students who pursue degrees through off-campus programs face a number of obstacles not normally encountered by traditional college students. Off-campus students often live too far from campus to attend on-campus classes, generally have a number of competing demands placed on their time, and are concerned with the costs associated with college (Hezel & Dirr, 1990; Thompson, Simonson & Hargrave, 1991). Some authors (Miller & Honeyman, 1993; Owen & Hotchkis, 1991) contend that videotaped instruction can be effectively used to reduce the negative effects of obstacles related to time, costs, and convenience. Many institutions of higher education, including Iowa State University's College of Agriculture, are using television and videocassettes to a greater extent than other media to capitalize on these benefits (Gunawardena, 1988; Miller & Honeyman, 1993).

Research is needed to understand the nature of graduates' experiences with off-campus degree programs. Also, research is needed to gain further understanding of the obstacles that most significantly impede the agricultural distant learner's ability to participate in and benefit from off-campus study. This type of research will aid decision makers in constructing quality off-campus programs that accommodate the needs and preferences of agricultural distant learners.

A number of studies (Brown, 1983; Miller & Honeyman, 1993; Weeks, 1987; Wilson, 1990) involving adult learners indicate generally positive attitudes toward videotaped instruction. What attitudes were held by graduates of the off-campus agricultural degree program, and what characteristics of the delivery media are most important for understanding these attitudes?

Development of the method and process for technology-mediated instruction is needed to advance distance education in agriculture. Miller and Honeyman (1994) identified a number of effective instructional practices for videotape that were espoused in the literature. What videotape teaching practices were important to graduates of an agricultural distance education program, and to what extent were the practices utilized by college teachers of agriculture?

Purpose and Objectives

The purpose of this study was to describe experiences of graduates with an off-campus agriculture degree program. Additionally, the researchers sought to describe selected teaching variables and attitudes related to agricultural courses delivered by videotape. The objectives of the study were as follows:

1. Describe selected variables related to graduates' experiences with an off-campus professional agriculture degree program.
2. Describe the perceptions held by graduates of an off-campus professional agriculture degree program related to obstacles encountered in off-campus study.
3. Describe graduates' perceptions regarding the importance of and the extent to which effective videotape instructional practices were utilized by instructors.
4. Describe attitudes of graduates toward the use of videotape as a tool for delivering agricultural courses.
5. Describe relationships between graduates' attitudes toward videotaped instruction and selected variables.

Procedures

Population

The population for the study consisted of all persons who had earned a bachelor's or master's of professional agriculture degree from Iowa State University. Forty-six master's degrees and seven bachelor's degrees had been awarded through fall semester, 1993. All graduates (N=53) were included in the study.

Instrumentation

The questionnaire included four Likert-type scales in addition to selected demographic questions and questions related to graduates' experiences with the off-campus program. Content and face validity for the questionnaire were established by a panel of faculty and graduate students in agricultural education.

A six point Likert-type scale with response categories ranging from insignificant (1) to significant (6) was used to measure graduates' perceptions related to obstacles faced by off-campus students. An item pool for the perception scale was generated by interviewing administrators, advisors, professors, and students associated with the off-campus professional agriculture degree program. Ten students enrolled in the off-campus program participated in a field test of the instrument. Ultimately, 13 obstacles were selected by the researcher to be included in the scale. Cronbach's alpha was calculated to estimate the internal consistency of the scale and resulted in a coefficient of .71.

Fifteen statements representing effective videotape instructional practices were selected from an instrument developed by Miller and Honeyman (1994). Each of the 15 statements received mean ratings of 4.25 or higher for importance on a five-point Likert-type scale in the Miller and Honeyman (1994) study. Graduates were asked to indicate their level of agreement with the statements regarding the extent to which the practices were important and the extent to which they had occurred. Data from the Miller and Honeyman (1994) study were used to estimate the internal consistency of the scales. Cronbach's alpha coefficients were .91 for the importance scale and .87 for the occurrence scale.

The scale for assessing attitudes toward videotaped instruction consisted of 11 Likert-type items, with five response categories ranging from strongly disagree (1) to strongly agree (5). The attitude scale was previously developed by Miller and Honeyman (1993) and had a Cronbach's alpha coefficient of .86.

Data Collection

Data for the study were collected by mailed questionnaire. The questionnaire, a cover letter, and a stamped return envelope were sent to all graduates of the professional agriculture degree program. Approximately four weeks after the initial package was mailed, a second complete package was sent to all nonrespondents. Two weeks after the second complete package was mailed, telephone calls were made to all nonrespondents to encourage their participation in the study. Forty-two master's graduates and four bachelor's graduates completed and returned the questionnaire for a response rate of 87%.

Analysis of Data

All data were analyzed with the SPSS/PC+ personal computer program. Appropriate statistics for description were used, including frequencies, percents, means, standard deviations, point biserial correlation and pearson correlations. All correlation coefficients were interpreted using Davis' (1971) descriptors.

Results

Graduates of the off-campus professional agriculture program ranged in age from 27 to 67 years. The mean age of graduates was 45 years with a standard deviation of 9. Approximately 89% (41) of the graduates were male.

Graduates were asked to rank four motivating factors for enrolling in the off-campus program. The graduates rated pursuing a degree as the most motivating factor followed by acquiring current technical knowledge, enjoyment of learning new information, and career advancement (Table 1).

The amount of time needed to complete the off-campus degree program ranged from a low of 24 months to a high of 126 months. A majority (58.7%) of graduates took more than 60 months to complete the program (Table 2).

Graduates of the off-campus program experienced a variety of delivery mechanisms for their courses. Several courses were taught at different sites in the state through conventional methods. Also, many students took courses by videotape whereas some took courses via satellite broadcast and through two-way audio and video communications technology. Generally, students were required to attend one or more on-campus sessions for each course even if the course was offered through distance education technologies. Table 3 shows that a majority (65.2%) of graduates traveled to campus 20 or fewer times. However, 13% of the graduates reported traveling to campus more than 31 times.

Table 1
Mean Rankings and Standard Deviations for Factors that Motivated Students to Enroll in the Off-Campus Program

Motive	Mean	Std. Dev.
Pursuing a degree	1.59	.90
Acquiring current technical knowledge	2.52	.99
For the enjoyment of learning new information	2.93	1.09
Career advancement	3.12	1.17

Table 2
Time in Months Taken by Students to Complete the Off-Campus Program

Number of Times	f	%	Cum %
13-24	1	2.2	2.2
25-36	3	6.5	8.7
37-48	5	10.9	19.6
49-60	10	21.7	41.3
61-72	9	19.5	60.9
73-84	9	19.5	80.4
85-96	5	10.9	91.3
97-108	2	4.4	95.7
109-120	1	2.2	97.8
121-132	1	2.2	100.0
Total	46	100.0	100.0

Mean 69.72 Std. Dev. 22.77

On a six point Likert-type scale, graduates were asked to rate the significance of 13 obstacles to off-campus study. Table 4 shows that 10.9% (five) of graduates provided a mean score between 1.51 and 2.50 (moderately insignificant), and 43.4% (20) provided a mean score between 2.51 and 3.50 (slightly insignificant). The remaining 45.7% (21) of graduates provided a mean score between 3.51 and 5.50 (slightly significant to moderately significant). The overall mean score for the perceived significance of obstacles to off-campus study was 3.34 (slightly insignificant) with a standard deviation of .67.

Table 3
Number of Times Respondents Traveled to Campus for Reasons Related to the Off-Campus Program

Number of Times	f	%	Cum %
0 to 10	18	39.1	39.1
11 to 20	12	26.1	65.2
21 to 30	10	21.7	87.0
31 to 40	4	8.7	95.7
41 to 50	1	2.2	97.8
51 to 60	1	2.2	100.0
Total	46	100.0	100.0

Table 4
Overall Mean Scores for the Perceived Significance of 13 Obstacles to Off-Campus Study

Mean f	%	Cum %	
1.51-2.50	5	10.9	10.9
2.51-3.50	20	43.4	54.3
3.51-4.50	19	41.4	95.7
4.51-5.50	2	4.3	100.0
Total 46	100.0	100.0	

Mean 3.34 Std. Dev. .67
Note:Based on Scale: 1 = insignificant; 2 = moderately insignificant; 3 = slightly insignificant;
4 = slightly significant; 5 = moderately significant; 6 = significant.

The percentages of respondents who rated each obstacle as slightly significant to significant are presented in Table 5. Four obstacles were perceived to be slightly significant to significant by a majority of graduates. The four obstacles were related to limited course offerings, difficulty in balancing responsibilities, access to library facilities, and program costs. Obstacles related to course prerequisites, financial aid, faculty understanding of student needs, and dealing with a number of departments were least significant.

Table 5
Percentage of Respondents Who Selected Slightly Significant, Moderately Significant, or Significant for Each Obstacle

Obstacle	%
1. Limited number of courses offered.	82.6
2. Difficulty in balancing school, personal, and work responsibilities.	71.7
3. Lack of access to library facilities.	65.2
4. Cost of the program.	60.9
5. Attending sessions held on campus.	47.8
6. Course offerings did not fit needs.	47.8
7. Lack of scholarships	47.8
8. Lack of access to instructors.	47.8
9. Lack of access to other students.	43.5
10. Dealing with a number of different departments.	39.1
11. Faculty did not understand student needs.	37.0
12. Accessing financial aid at the University.	34.8
13. Prerequisites required for classes.	19.6

Sixty-three percent (29) of the 42 respondents had taken at least one videotaped course through the off-campus professional agriculture degree program. This group of 29 graduates provided data for the objectives related to videotape course delivery. Graduates, on average, had taken 4 videotaped courses with a range of 1 to 15 and a standard deviation of 3.86.

Table 6 presents means and standard deviations for individual items on the importance and occurrence scale. Arguably, each of the 15 practices applies not only to the distant setting but also to conventional settings. Farr and Shaeffer (1993) suggested that the principles of distance education and conventional education are analogous. However, the 15 practices listed in Table 6 are particularly important for distant learners (Cyrs & Smith, 1990; Gibson, 1985; Miller & Honeyman, 1994; Thompson, Simonson & Hargrave, 1991; Wilson, 1991). Graduates agreed that each practice was important for their learning and that each had occurred in their videotaped course(s), but graduates provided higher mean scores for importance than for occurrence on each of the 15 practices.

Graduates' attitudes toward videotaped instruction were measured with a five-point Likert-type scale. Table 7 shows that 75.9% (22) of the graduates provided mean attitude scores greater than 3.5 (agree to strongly agree). Only 3.4% (1) of the graduates provided a mean score less than 2.50 (disagree), and the remaining 20.7% (6) of the graduates provided mean attitude scores between 2.51 and 3.50 (undecided).

The researchers analyzed responses to individual items on the attitude scale and discovered that graduates provided more positive responses for items related to convenience, opportunity for learning, control of pace, and whether or not they would be willing to take additional videotaped courses. Items that yielded lower mean scores indicated that graduates felt isolated and would prefer traditional methods of instructional delivery over videotape.

Table 6

Means and Standard Deviations for Videotape Instructional Practices on the Importance and Occurrence Scale

Item		Importance		Occurrence	
		Mean	S.D.	Mean	S.D.
1.	The instructor(s) demonstrated command of the material that they were teaching.	4.52	.51	4.28	.59
2.	Supporting materials (text, study guide, etc.) contributed to my understanding of the courses(s).	4.46	.50	3.72	.88
3.	The instructor(s) were enthusiastic.	4.38	.56	3.90	1.01
4.	The instructor(s) spoke clearly.	4.38	.56	4.14	.58
5.	Lessons were interesting.	4.35	.61	3.62	1.05
6.	The instructor(s) made clear the relative importance of the information presented.	4.31	.76	3.66	.90
7.	The instruction required me to think.	4.31	.47	3.90	.86
8.	The instructor(s) provided a structured outline of content to be taught.	4.28	.53	3.93	.37
9.	Tests required application of the course content.	4.28	.59	4.07	.75
10.	The instructor(s) spoke at an appropriate pace.	4.24	.58	4.03	.57
11.	The organization of content within a given lesson was logical.	4.24	.58	3.90	.49
12.	The instructor(s) effectively communicated the material to be learned.	4.24	.69	3.75	.79
13.	The instructor(s) demonstrated the interrelatedness of the course concepts.	4.17	.76	3.62	.68
14.	The instructors explained what I should know or be able to do as a result of viewing the videotapes.	4.14	.64	3.48	.91
15.	"Real world" application of content was stressed by the instructor(s).	4.11	.67	3.63	.97

Table 7

Overall Mean Scores for Attitude Toward Videotaped Instruction

Mean	f	%	Cum %
1.51-2.00	1	3.4	3.4
2.01-2.50	0	0.0	3.4
2.51-3.00	2	6.9	10.3
3.01-3.50	4	13.8	24.1
3.51-4.00	14	48.3	72.4
4.01-4.50	6	20.7	93.1
4.51-5.00	2	6.9	100.0
Total	29	100.0	100.0

Mean 3.72 Std. Dev. .59

Note: Based on Scale: 1 = strongly disagree; 2= disagree; 3= undecided; 4= agree; 5=strongly agree

Pearson correlations and point biserial correlations were used to describe relationships between graduate's attitude toward videotaped instruction and selected variables (Table 8). A low positive relationship was found between attitude and gender. A low negative relationship was found between attitude and age. A moderate positive relationship existed between attitude and number of videotaped courses taken, and a substantial positive relationship was found between attitude and perceived occurrence of the videotape instructional practices. Students with more positive attitudes toward videotaped instruction tended to be female, were younger, had taken more videotaped courses, and perceived to a greater extent the occurrence of the videotaped instructional practices.

Table 8

Summary of Relationships Between Attitude Toward Videotaped Instruction and Selected Variables

Variable	Association
Occurrence of effective practices	.50
No. videotaped courses completed	.37
Age	-.22
Gender [a]	.22

[a] r_{pb}

Conclusions and/or Recommendations

Most graduates of the professional agriculture program took five or more years to complete the requirements for their degree and considered the limited number of course offerings to be the most significant obstacle to off-campus study. More agricultural courses should be offered through fiber optics, satellite broadcasts, and videotape to accommodate the educational needs of distance learners and to facilitate a more timely completion of their degree requirements. Administrators should make efforts to encourage greater participation of college faculty in the delivery of off-campus courses. Administrators must recognize the additional efforts required of instructors who teach at a distance and consider this when evaluating the work of faculty members.

One of the often cited benefits of distance education is a reduction in the need to travel. This reduction of travel allows students to better use their time in balancing school, work, and personal responsibilities. Hezel and Dirr (1990) recognized the importance of time to the distant learner when they wrote, "although the term 'distance education' is becoming the accepted term for describing new educational opportunities that offer students flexibility for pursuing their degrees, time rather than distance seems to be the major constraint facing those students." (p. 6) Most graduates traveled to campus 20 or fewer times for reasons related to the off-campus professional agriculture degree program. Twenty trips to campus may be reasonable considering that most graduates took five or more years to complete their degree requirements, but advanced communications technology must be exploited further to reduce the amount of travel required of students. Also, partnerships between the university and secondary agriculture teachers, community colleges, and outlying research centers should be established. Students should be able to complete laboratory activities and obtain academic assistance from individuals and institutions in their local communities.

Overall, the obstacles to off-campus study were perceived to be slightly insignificant by graduates of the program. However, a majority of graduates perceived that limited course offerings, difficulty in balancing responsibilities, and program costs were slightly significant to significant barriers. Administrators should attempt to eliminate or minimize the effects of each of these barriers. Data from this investigation have been requested by and delivered to persons within the university responsible for policy decisions related to each of the obstacles.

Overall, graduates perceived the 15 videotape instructional practices to be important for their learning and perceived that the practices had occurred in the videotaped course(s) they had taken. However, the extent to which the practices had occurred was lower than the perceived importance for each of the practices. College of agriculture faculty were doing a relatively good job of teaching through videotape, but efforts should be made to help faculty integrate more of the effective practices into their instruction. College of agriculture faculty should be provided an opportunity to participate in a formal program aimed at assisting them in improving the design, organization, and delivery of agricultural courses offered via one-way instructional television. This assistance should be based on sound scholarship. Therefore, further research is needed to determine which teaching methods and strategies are most appropriate for specific delivery systems and groups of learners. A study by Miller and Lehtola (1994) provides an example of the type of research needed to further develop the method and process of technology mediated instruction.

A majority of graduates held positive to strongly positive attitudes toward videotaped instruction. Graduates were most positive about the opportunity for learning provided by videotape, the ability to control the pace of their learning, and convenience. This conclusion is consistent with the work of Miller and Honeyman (1993) and with the desirability indicators of distance education that were identified by Gulliver and Wright (1989). Videotaped instruction provides a suitable means of offering credit courses to distant learners. This study shows that graduates were more positive about videotaped instruction when they perceived to a greater extent the occurrence of effective practices. Therefore, quality instruction is key to maintaining the acceptability of this medium with distant learners.

The results of this study have direct implications for college teaching -- particularly distance teaching. Data from this study illustrate learning strategies and preferences of a select group of agricultural distance learners. Faculty should routinely consider the learning preferences of their students when planning, organizing, and delivering courses. Faculty should also consider that any instructional media, including videotape, will be more or less obliging to a particular student's learning style (Ullmer, 1994). A challenge to college teachers of agriculture is to discover innovative teaching strategies that exploit the potential of the teaching medium. A body of research exists which demonstrates a significant improvement in student achievement and attitudes when teaching styles are congruent with learner preferences (Griggs, 1991).

The instructional practices listed in Table 6 were considered to be important for learning by the graduates of the professional agriculture degree program, and the extent to which graduates perceived the practices had occurred was positively related to their attitude toward videotaped instruction. Agriculture faculty who teach at a distance might consider doing a self-assessment and ask their students to assess the extent to which they use the practices. A small number of practices could be targeted and consciously integrated into distance teaching. Feedback on the extent to which the practice was effectively used could be sought from colleagues and from students enrolled in their course(s).

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Title:

Teaching Through Fiber-Optics Telecommunications Technology: Possibilities and Priorities for Agriculture

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Introduction

> It is traditional to think of adult learners when distance education is mentioned. Indeed, the greatest percentage of distance students have been adults. That tradition is changing. With the implementation of well funded programs, such as the U. S. Federal government's Star Schools Program, the vast possibilities of distance learning are being increasingly offered to K-12 student populations (Schlosser & Anderson, 1993, p. 37).

Many states have or are installing technology which will enable all levels of education to utilize distance education (Moore & Thompson, 1990; School Tech News, 1986). This may be good news for secondary agricultural education programs. According to the National Research Council (1988), educators must create new ways to deliver agricultural education to a greater number of students. The Iowa Communications Network may provide a suitable mechanism for delivering agricultural instruction to a larger audience of youth and adults.

Will distance education technology be accepted by secondary educators in general and agricultural educators specifically? Faculty resistance is often cited as a major barrier to the implementation of distance education technology (Dillon & Walsh, 1992). Currently, few secondary educators have knowledge related to distance education. And, faculty are seldom the subjects of research in distance education (Dillon et. al. 1992).

Negative teacher attitudes, additional workloads, lack of funding, reduced student interaction, lack of time, fear of job loss, fear of technology, and technical problems have all been identified as obstacles to the adoption of distance education technologies (Bruder, 1989; Dillon & Walsh, 1992; Hansford & Baker, 1990; Jackson & Bowen, 1993; Jurasek, 1993; Koontz, 1989; Swan & Brehmer, 1992). Teacher experience with technology seems to be key in overcoming such barriers, however. Several researchers (Dillon & Walsh, 1992; Jurasek, 1993; Koontz, 1989) have concluded that faculty with distance teaching experience generally have more positive attitudes toward technology mediated instruction.

The transfer of technology from researcher to end user is a complex process and may be useful to researchers in understanding some teachers' initial resistance to distance education technology. Five distinct phases have been identified that take place in the adoption process. These phases are awareness, interest, evaluation, trial, and adoption (Lionberger & Gwin, 1982; Rollins, 1993). At the awareness stage, the teachers have heard about or read about the technology, while at the interest stage they want to know more about the technology and how it works. The evaluation stage involves the teacher's "mental" decision to try, or not to try the technology. In the trial stage, use of the technology starts slowly and increases as the teacher begins to appreciate the technology. Once convinced of the usefulness of the technology, the teacher enters the adoption phase and implements the technology.

Rate of movement from one stage of the adoption process to the next can vary widely, and research indicates that speed of adoption cannot be increased by skipping stages (Lionberger & Gwin, 1982). Other considerations related to the rate of adoption include teachers' willingness to change, individual differences, ability to understand the technology, and available funding.

Distance education technologies may be able to help facilitate the modernization and improvement of secondary agricultural education programs. But, several questions must be answered before this can occur. What are the attitudes of teachers toward delivering instruction via interactive communications networks, and what obstacles might inhibit their use of such systems? Also, what priorities should be established for collaboration among existing agriculture programs and for course offerings to schools without agriculture programs?

Purpose and Objectives

The purpose of this descriptive study was to investigate the usefulness of an interactive communications network for agricultural education at the secondary level. The Iowa Communications Network (ICN) is a 2-way full motion fiber optics telecommunications system capable of linking secondary agricultural education departments throughout Iowa. The objectives of the study were to:

1. Describe obstacles that may inhibit use of the ICN as perceived by secondary agriculture teachers.
2. Describe secondary agriculture teachers' attitude toward using the ICN for delivering agricultural instruction.
3. Describe relationships between teachers' attitude, perceived obstacles, and selected variables.
4. Identify priorities for collaboration among secondary agriculture programs in delivering instruction over the ICN.
5. Identify courses offered in secondary agriculture programs that are suitable or unsuitable for delivery via the ICN.

Procedures

The population for the study consisted of all secondary teachers of agricultural education in Iowa (N=216). Based on Krejcie and Morgan's (1970) formula for a 5% margin of error, a random sample of 140 teachers was selected to participate in the study.

The questionnaire utilized in the study consisted of 4 parts including the attitude toward the ICN scale, obstacles that may inhibit use of the ICN scale, questions related to collaboration and potential course offerings, and selected demographic questions. Content and face validity were established by a panel of experts in agricultural education.

Obstacles that may inhibit the use of the ICN by secondary agriculture teachers were identified by interviewing persons responsible for administering different aspects of the ICN, agriculture teachers not included in the sample, and from an instrument used by Swan (1992) for a similar purpose in North Dakota. Response categories for the Likert-type scale ranged from insignificant (1) to significant (6). The Cronbach's alpha reliability coefficient for the obstacles scale was .82.

Teachers' attitude toward the ICN was measured with a 28 item Likert-type scale, with five response categories ranging from strongly disagree (1) to strongly agree (5). The attitudinal instrument was tested for suitability and reliability with a group of 10 teachers not included in the sample. The Cronbach's alpha reliability estimate was .93.

The questionnaire, along with a cover letter and a stamped return envelope, was sent to all secondary agriculture teachers included in the sample. After 10 days, a second mailing was sent to all nonrespondents. Ten days after the second mailing, a reminder letter was sent to all nonrespondents stressing the importance of their participation. Approximately 10 days following the third mailing, telephone calls were made to the nonrespondents. One hundred and two teachers completed and returned the questionnaire for a response rate of 73%. Nonresponse error was controlled by comparing early to late respondents (Miller & Smith, 1983). No significant differences were found between early and late respondents.

Analysis of Data

All data were analyzed with the SPSS/PC+ personal computer program. Appropriate statistics for description (frequencies, percents, means, standard deviations, pearson correlations, and point biserial correlations) were used. The alpha level was set a priori at .05, and Davis' (1971) descriptors were used to interpret all correlation coefficients.

Results

The agricultural educators who participated in the study ranged in age from 23 to 64 years. The mean age of respondents was 36.94 with a standard deviation of 9.50. In regard to gender, 90.2% (92) of the teachers were male.

Teachers were asked to report their highest level of education. Bachelors degrees were held by 71% (66) percent of the respondents, 26.9% (25) of the teachers held masters degrees, and 2.2% (2) held doctoral degrees. Teachers were also asked to indicate the number of years they had taught agricultural education, and whether on not they had tenure. Years of experience ranged from one to 35 with a mean of 12.44 and a standard deviation of 8.51. Approximately three-quarters (77) of the teachers had tenure in their current positions.

The teachers were asked if their school was currently connected to the ICN. They were also asked if they had ever taught or taken a class via the ICN. At the time of the survey, 22.5% (22) of the schools represented by the agriculture teachers were connected to the ICN. None of the teachers had taught using this technology. Nine teachers (9.1%) indicated that they had taken at least one course via the ICN.

The teachers responded to sixteen statements representing obstacles which might inhibit their use of the ICN. A Likert-type scale with response categories ranging from insignificant (1) to significant (6) was utilized. Table 1 shows that forty-eight percent (49) of the teachers provided a mean score in the range of 4.51 to 5.50 (moderately significant). Approximately 39% (38) of the teachers reported mean scores in the range of 3.51-4.50 (slightly significant). Means scores in the range of 1.51-3.50 (moderately or slightly insignificant) were reported by less than eight percent (8) of the teachers. The overall mean score for the 16 obstacles was 4.49 (slightly significant), with a standard deviation of .63.

Table 1
Overall Mean Scores for Obstacles that May Inhibit Use of the Iowa Communications Network by Agriculture Teachers

Mean	f	%	Cum %
1.51-2.50	1	1.0	1.0
2.51-3.50	7	6.8	7.8
3.51-4.50	38	39.3	47.1
4.51-5.50	49	48.0	95.1
5.51-6.00	5	4.9	100.0
Total	102	100.0	100.0

Mean 4.49 Std. Dev. .63

Note: Based on Scale: 1 = insignificant; 2 = moderately insignificant; 3 = slightly insignificant; 4 = slightly significant; 5 = moderately significant; 6 = significant

Table 2 shows the percentage of teachers who selected slightly significant, moderately significant, or significant for each of the sixteen obstacles. School and class scheduling problems were considered most significant by the agricultural educators. Lack of local support staff, the inability to have lab sessions, and materials distribution were each considered slightly significant, moderately significant, or significant by 87.3% of the teachers. Costs, lack of training, and preparation time were considered slightly significant to significant obstacles by 80-85% of the agriculture teachers. Obstacles receiving the lowest frequencies in the slightly significant, moderately significant, or significant categories were lack of student interest and negative attitudes of teachers towards the ICN.

Table 2
Percentage of Teachers Who Selected Slightly Significant, Moderately Significant, or Significant for Each Obstacle

Obstacle		%
1.	Coordination of schedules between schools.	94.1
2.	The ICN could create scheduling problems.	88.2
3.	Laboratory sessions cannot be taught via the ICN.	87.3
4.	Distributing materials between sites.	87.3
5.	Lack of local support staff.	87.3
6.	Supervised agricultural experiences cannot be managed via the ICN.	86.3
7.	Costs associated with using the ICN.	85.3
8.	Lack of training.	83.3
9.	Preparation time needed by teachers.	82.4
10.	Fear that the ICN would reduce the number of agriculture programs.	78.4
11.	Agriculture teachers are to busy to teach via the ICN.	77.5
12.	Lack of incentives for teaching via the ICN.	77.5
13.	Administrators do not understand teachers' needs when teaching via the ICN.	77.5
14.	Difficulty in establishing cooperative relationships among schools.	68.6
15.	Negative attitude of teachers towards the ICN.	61.8
16.	Lack of student interest.	58.8

On a five-point Likert-type scale, teachers were asked to respond to 28 statements related to their attitude toward the use of the ICN to teach agriculture. Table 3 shows that 62.7% (64) of the teachers provided a mean score in the range of 2.51 to 3.50 (undecided). An additional 32% (33) of the agriculture teachers provided a mean score in the range of 3.51-4.50 (agree). The remaining 4.9% (5) of the teachers provided mean scores between 1.51 and 2.50 (disagree). The overall mean score for the 28 attitudinal statements was 3.26 (undecided) with a standard deviation of .47.

Table 3
Overall Mean Scores for Agriculture Teachers' Attitude Toward Using the Iowa Communications Network to Teach Agriculture

Mean	f	%	Cum %
1.51-2.50	5	4.9	4.9
2.51-3.50	64	62.7	67.6
3.51-4.50	33	32.4	100.0
Total	102	100.0	100.0

Mean 3.26 Std. Dev. .47
Note: Based on Scale: 1 = strongly disagree; 2= disagree; 3= undecided; 4= agree; 5=strongly agree

Pearson correlations and point biserial correlations were used to describe relationships between obstacles that may inhibit the use of the ICN and selected variables (Table 4). The associations ranged in magnitude from negligible to moderate. Teachers who provided higher scores on the obstacles scale tended to have less positive attitudes towards the ICN, were less likely to be located in a school connected to the ICN, and were younger. The association between years of teaching experience and perceived significance of the obstacles was negligible.

Table 4
Summary of Relationships Between Obstacles That May Inhibit Use of the ICN and Selected Variables

Variable	Association
Attitude toward ICN	-.36*
School connected to ICN	-.13
Years of teaching experience	-.08
Age	-.16

* p = >.05

Table 5 shows the associations between attitude toward using the ICN for delivering agricultural instruction and selected variables. The associations ranged in magnitude from negligible to low. Female agriculture teachers tended to have more positive attitudes towards using the ICN to teach agriculture. The association between years of teaching experience, connection to the ICN, and age were negligible.

Table 5
Summary of Relationships Between Attitude Toward the ICN and Selected Variables

Variable	Association
School connected to ICN	.06
Years of teaching experience	-.07
Gender	.21*
Age	.01

* p = >.05

Agriculture teachers were asked to list units of instruction that they would like to receive from other agriculture programs through the ICN. A total of 275 units of instruction were listed by the 102 agriculture teachers participating in the study. Units of instruction were placed into 12 content-related categories by the researchers. Table 6 shows that units related to agricultural economics (25.8%) were listed most frequently as priority units for reception. Horticulture, floriculture, and landscaping units (13.8%) were the second most frequently cited units followed by animal sciences (11.2%), agronomy (9.5%), aquaculture (9.5%), agricultural mechanics (8.3%), and biotechnology (5.5%). Categories representing less than 5% of the total number of units included natural resources and the environment, careers in agriculture, computers, and leadership, FFA and SAE. Approximately 6% of the units were grouped into a miscellaneous category and included such units as forestry, food technology, international agriculture, and agricultural journalism.

Agriculture teachers were also asked to list units of instruction that they would be willing to teach via the ICN. A total of 164 units of instruction were listed by the 102 agriculture teachers who participated in the study. Table 6 shows that units related to animal sciences (25.6%) were listed most frequently as priority units for delivery. The second most frequently cited category was agricultural economics (23.2%) and was followed by agronomy (11.6%), horticulture, floriculture, and landscaping (8.5%), agricultural mechanics (7.3%), and leadership, FFA, and SAE (5.5%). Categories representing less than 5% of the total number of units included natural resources and the environment, computers, careers in agriculture, biotechnology, aquaculture, and the miscellaneous category.

Due to the nature of the instruction in secondary agriculture programs, it could be hypothesized that only select course offerings are suitable for delivery via the ICN. Agriculture teachers who participated in the study were asked to list titles of courses (semester or year-long) that could be delivered via the ICN to schools without an agriculture teacher. A total of 210 course titles were listed by the agriculture teachers. The researchers collapsed the course titles into nine categories which are presented in Table 7. Course titles related to agricultural economics (35.2%) were listed most often as courses that were suitable for delivery via ICN. The second most frequently cited category of course titles was agronomy (19.5%) and was followed by animal sciences (18.6%), horticulture, floriculture, and landscaping (5.7%), and natural resources and the environment (5.2%). Categories representing less than 5% of the course titles included agricultural mechanics, leadership, FFA, and SAE, and aquaculture. Approximately 11% of the course titles were grouped into a miscellaneous category and included such titles as agricultural communications, Iowa agriculture, agricultural issues, and agricultural chemicals.

Table 6
Categories of Priority Units of Instruction that Agriculture Teachers Desire to Receive or Would be Willing to Deliver via the ICN

Unit	Receive		Deliver	
	f	%	f	%
Agricultural Economics	71	25.8	38	23.2
Horticulture/Floriculture/Landscaping	38	13.8	14	8.5
Animal Sciences	31	11.2	42	25.6
Agronomy	26	9.5	19	11.6
Aquaculture	26	9.5	4	2.4
Agricultural Mechanics	23	8.3	12	7.3
Biotechnology	15	5.5	4	2.4
Natural Resources/Environment	13	4.7	6	3.7
Careers in Agriculture	6	2.2	4	2.4
Computers	5	1.8	5	3.1
Leadership/FFA/SAE	4	1.5	9	5.5
Miscellaneous	17	6.2	7	4.3
Total	275	100.0	164	100.0

Table 7
Categories of Priority Courses That Could be Offered via the ICN to Schools with no Agriculture Teacher

Course	Suitable		Not Suitable	
	f	%	f	%
Agricultural Economics	74	35.2	9	4.8
Agronomy	41	19.5	19	10.2
Animal Sciences	39	18.6	12	6.5
Horticulture/Floriculture/Landscaping	12	5.7	30	16.1
Natural Resources/Environment	11	5.2	5	2.7
Agricultural Mechanics	6	2.9	88	47.3
Leadership/FFA/SAE	3	1.4	8	4.3
Aquaculture	1	.5	5	2.7
Miscellaneous	23	11.0	10	5.4
Total	210	100.0	186	100.0

Agriculture teachers were also asked to list titles of courses (semester or year-long) that would be unsuitable for ICN delivery. A total of 186 course titles were listed by the agriculture teachers. Table 7 shows that agricultural mechanics courses (47.3%) were most frequently cited as not suitable for ICN delivery followed by horticulture, floriculture, and landscaping courses (16.1%), agronomy courses (10.2%), animal science courses (6.5%), and miscellaneous course titles (5.4%). Categories representing less than 5% of the course titles included agricultural economics, natural resources and the environment, leadership, FFA, and SAE, and aquaculture.

Conclusions and/or Recommendations

Overall, the 16 obstacles to using the ICN in secondary agriculture programs were perceived to be slightly significant. Teachers were most concerned with scheduling problems, but were also concerned that laboratory sessions and supervised agricultural experience programs could not be managed over the system. Additionally, the respondents were concerned with costs, lack of training, and incentives for using the system.

Perhaps scheduling, training, and incentives are less problematic than concerns related to supervised agricultural experiences and laboratory experiences. Can quality programs in agricultural education be delivered while sacrificing the application of learning provided through supervised agricultural experiences and laboratory experiences? Do agriculture teachers really have to sacrifice these components of an agriculture program? It was recommended that pilot or demonstration programs be developed that include laboratory and hands-on learning experiences within the interactive distance education delivery mechanism. The interactive and video components of distance education should be exploited to demonstrate viable alternatives to conventional methods of teaching agricultural education.

Data suggest that secondary agriculture teachers are undecided about using the ICN as a tool for teaching agriculture. If attitudes are a reflection of an individual's personal perspective and are strongly predictive of behavior (Na and Lee, 1993), what does this tell us about agriculture teachers' willingness to use this educational technology? Perhaps Lionberger et al.'s (1982) adoption process theory could explain the current situation. The ICN was connected to less than 25% of the schools represented in this study. This might indicate that most of the secondary agriculture teachers were at the early stages of the adoption process. Maybe the teachers' indecisiveness about using the ICN was related to their status in the adoption process. It was recommended that teacher educators provide secondary agriculture teachers with current information related to the ICN to increase awareness and stimulate interest. Also, secondary agricultural education teachers should be provided opportunities, both as a recipient and provider of distance education, to gain experience with ICN technology. Studies in technology have shown that teacher attitudes become more positive as a result of experience with technology (Na, S. & Lee, M., 1993; Rollins, 1993).

The highest priority for collaborative efforts among schools with agriculture programs were in the areas of agricultural economics and horticulture. Teachers also cited units of instruction (aquaculture and biotechnology) that are related to current curriculum initiatives in agricultural education as priorities for collaboration. Teacher educators should plan, organize, and deliver inservice education for agriculture teachers in curriculum development and strategies for lesson presentation particularly for agricultural economics and horticulture related units. The data suggest an adequate number of teachers are willing to teach units of instruction in the priority areas via the ICN. Teacher educators should promote the involvement of secondary agricultural education teachers in using the system to improve agriculture curriculum in secondary agriculture programs.

Interestingly, different teachers perceived the same content-related categories of courses to be both suitable and unsuitable for delivery via the ICN to schools with no agriculture teacher. A clear pattern was evident regarding the suitability of agricultural mechanics courses and agricultural economics courses. Teachers generally agreed that agricultural mechanics courses were not suited to ICN delivery, but agricultural economics courses were suited to ICN delivery. Teacher educators, secondary agriculture teachers, administrators and others with an interest in agriculture should work collaboratively to facilitate the delivery of instruction in and about agriculture to schools without agriculture teachers. The teachers who participated in this study placed considerable emphasis on agricultural economics, but agronomy and animal sciences courses were also listed as promising areas for course delivery.

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Title:

The Educational Media and Technology Profession: An Agenda for Research and Assessment of the Knowledge Base

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Introduction

Who are we? Where are we going? What useful purpose do we serve? Such introspective questions--although viewed as pointless by some--are necessary questions for a profession to ask of itself periodically. During the late 1980s the board of directors of the Association for Educational Communications and Technology (AECT) undertook strategic planning for the future of association. They began by looking at the members who constitute the organization and who populate the educational media and technology (em/t) profession. As they did so, they realized that there are many questions about "who we are" and "where we are going" that could not be answered with any degree of certainty. The data either didn't exist or weren't readily accessible.

This dearth of information about the profession was considered serious enough to set up a task force, later a committee, on "Research on the Profession." This committee, chaired first by George Grimes and later by Michael Molenda, operated from 1990 to 1994 with the charge of doing something to remedy this information gap. The group decided that a long-term solution must include the promotion of continuing research about the educational media and technology profession and the establishment of a mechanism for making this research available to those seeking information.

Fortunately, the committee discovered early that Donald P. Ely, director of the ERIC Clearinghouse on Information and Technology, had already committed the Clearinghouse to serving the storage and dissemination functions envisioned by the committee. From that point the committee focused on a strategy of:

-staking out the territory to be included in "research on the profession,"
-determining where the knowledge gaps are, and
-encouraging further research to fill those knowledge gaps.

This report is the first effort to stake out the territory and explore the existing knowledge base within that territory. It is the hope of the committee that this Agenda will stimulate interest among researchers and apprentice researchers. It comprises a set of questions, the answers to which cast light on who we are, where we are going, and what useful purpose we serve.

A preliminary draft of this paper was presented at the 1995 AECT annual convention. Reactions were given by Donald Ely, Sandy Patton, and Philip Doughty. Each made valuable substantive suggestions which have been incorporated into this "Proceedings" version.

The Agenda

I. Definition of the field

A. Boundaries: What is the currently accepted definition of the educational media and technology (em/t) field?

°within the profession

°among outside individuals and groups

B. Image: How is the field perceived?

°within the profession

°among outside individuals and groups

C. Historical Perspective: How have perceptions changed over time?

D. Justification for existence: Are em/t specialists needed? What valuable functions do they serve...within organization?...within society? What potential harm might be caused by ignorant, incompetent, or unethical practice? Are employers well informed about qualifications em/t professionals should possess?

II. Positions held

A. Position Titles: What positions are currently held by em/t professionals

...in schools?
...in higher education?
...in business/industry?
...in government?
...other?

B. Marketplace: What sorts of positions are currently being advertised?

C. Qualifications: What entry qualifications are expected by employers?

D. Marketplace Status: Is there a balance between supply and demand of graduates?

E. Roles: How are the roles of em/t specialists defined?

° What different roles are defined and advocated within the field?

° What different roles are actually being played by practitioners?

° What do exemplary performers do that makes them exemplary?

F. Career Paths: What are typical career paths followed by em/t professionals?

G. Position/Role Trends: Is there a pattern of change in the types of positions available, the supply of qualified applicants, the roles played, or career paths?

III. Compensations vs. Demands

A. Compensation Status: What are the current salary ranges for different positions? Other compensations?

B. Compensation Variables: Do salaries vary by educational level? Geographical location? Workplace? Gender? Other variables?

C. Compensation Trends: Is there a pattern of change in salaries or other compensations?

D. Job Demands: What responsibilities do em/t professionals have? What special stresses are they subjected to?
E. Job Demand Trends: How are job demands changing? How are stresses changing?

IV. Professional Preparation and Standards

A. Academic Study Opportunities: Where are degrees in em/t offered?

°Master's
°Specialist/Certificate
°Doctoral

B. Distribution of Students: How many students graduate from each program/degree?

C. Academic Curricula: What are the curricula offered in these programs? How do they differ?

D. Core Curriculum: To what extent is there agreement on a "core curriculum?"

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E. Program Quality: Are there evaluative data about these programs? (e.g. relative to relevance of curricula to career preparedness)

F. Preparation/Practice Match: What sorts of training are most valuable in helping students become successful practitioners?

G. Academic Program Trends: Are the number or type of programs or graduates changing? Are the curricula changing? Are the programs flourishing, declining, remaining steady?

H. Continuing Professional Development: What sorts of continuing education are needed? Wanted?

I. Standards: What standards of professional competence or ethical codes are advocated? Enforced?

V. Communications

A. Communications among professionals: How do professionals communicate among themselves?

° adequacy of journals and periodicals

° accessibility of publications

B. Information sources: How is needed information stored and retrieved?

° accessibility of print and electronic databases

C. Linkages: How do professionals, individually and in groups, connect with others?

° on a local and regional basis?
° on a national basis?

° on an international basis?

VI. Professional Organizations

A. Membership: Which professional organizations do em/t professionals belong to?

°national level
°state level
°local level

B. Membership Overlap: To what degree is there overlap in membership among associations?

C. Association Functions: What sorts of services are offered or activities are undertaken by these associations?

D. Association Leadership: Who hold leadership positions in these associations? How are positions of leadership gained? What provision is made for leadership development?

E. Association Trends: Any change in the pattern of association membership? How are internal and external forces affecting the growth and health of professional organizations?

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VII. The Workplace

A. Workplace Settings: In what organizational settings do em/t professionals work? (e.g. school or college media centers, local or state school agencies, university academic departments, corporations, etc.)

B. Workplace Satisfaction: Do em/t professionals experience satisfaction with their workplace environment?

C. Job Satisfaction: Do em/t professionals experience satisfaction in their jobs?

D. Workplace Trends: Are these organizational settings declining or growing in number? Are they declining or growing in financial support? Are roles changing? In what ways?

VII. External forces

A. Societal Forces: What societal forces are affecting the profession? What are the forces that assist or impede the appropriate adoption of technology in education?

B. Governance Forces: What changes are taking place in the governance of public K-12 education? Public and private higher education? How are these governance changes affecting the em/t profession? How do these forces aid or impede the appropriate adoption of technology?

C. Workplace Forces: What workplace forces are affecting the profession?

D. Technological Forces: How are technological forces affecting the profession? How does change in technology itself affect the adoption or rejection of technology in education and training?

E. Historical Patterns and Trends: Historically, what has been the impact of various external forces on the size of, shape of, or directions taken by the field?

The Knowledge Base

We see two steps being critical to establishing the knowledge base of the em/t field: first, surveying the literature on the profession of educational technology, and second, assessing the literature for adequacy, gaps, obsolescence, and so on. We are reporting the first step here in the form of a selected bibliography of works about this profession. It is based on a larger database--of some 495 citations--that is published separately by Educational Technology Publications as *The Educational Technology Profession: A Bibliographic Overview of a Profession in Search of Itself* by J. Fred Olive; edited by the series editor, William D. Milheim.

The second step entails a critical analysis of the database, assessing what is known for its completeness and up-to-date-ness and looking for gaps in the knowledge base. This is the larger task that still remains. We invite other scholars to join in this endeavor.

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Title:

Effects of Animation & Visuals on Learning High School Mathematics

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MULTIMEDIA

Educators have used the term multimedia in a global sense for years: outside the classroom the term was rarely heard. Research on components of multimedia was spurred after the second World War by the military interested in increasing training effectiveness and conducted by new research graduates eager to carry out the studies. For example, a research team was formed at Penn State which for years investigated the effects of movies on learning outcomes. Later the thrust moved to video and through the work of Dwyer and others has concentrated on the roles of graphics and color in learning.

In recent years, the prospects of huge businesses to be spun out of the multimedia and information superhighway efforts has brought the term multimedia out of the closet and into the public view. For example, Naisbitt (1994) in his newest look to the future has written that multimedia will become a dominant force in the next decade and the two most significant applications will consist of entertainment and education. On the communications-side of things, software giant Microsoft and cellular phone giant McCaw recently announced plans to blanket the earth with communcations satellite to make electronic communication available anywhere in the world. The potential for such systems to impact education and training is enormous, but what does the research tells us about the field.

For now multimedia may be defined as the components of conventional media (computer, video, graphics, animation, audio, color) along with their path to complete integration, which is now just in its infancy.

On the assumption that understanding and directing the formation of the whole can be increased by examining its parts, this paper will examines the multimedia component of animation. Animation is examined as it is the new kid on the block and which will likely grow quickly as the hardware and software systems which brought us desktop publishing and desktop video will soon bring desktop animation to educators and trainers.

GRAPHICS AND ANIMATION IN INSTRUCTION

Research Findings

Graphics in instruction is defined as any representation of an object, concept or process, as perceived through the eye, which does not rely on the use of text or numbers. Animation refers to the use of a series of graphics which change over time.

Extensive research on graphics occured during the 1960's and 70's and has diminished in recent years. Subsequent to these studies which support the positive effects of graphics on achievement, the computer has become the dominant mode of instruction in education. Apparently researchers believe the findings and conclusions will continue to be valid with graphics delivered by computer based instruction (CBI). This argument makes the plausible assumption that the type of feature represented in instruction is more important than the number of different ways it is represented.

It was found that graphics and visuals increase the amount learned by adults (Alesandrini, 1984) and by children (Pressley, 1977). Alesandrini and Rigney (1981) found graphics to be an effective review strategy compared with verbal strategies. In a study which examined student attitude toward graphics-based learning, Rigney and Lutz (1976) concluded that using graphics as analogies in CBI resulted in high levels of satisfaction with the learning experience.

Willows (1978) was concerned about potential interference between the messages provided by text and graphics in textbooks. Unlike texts, CBI, permits control over the presentation to avoid such conflicts. For example, turning a page of a book may reveal a graphic and text, but with computer control, the graphic can be presented first and the text held until a certain time had expired, or vice versa.

Dwyer (1970) showed that simple line drawing graphics tend to be superior to photographs or other more realistic drawings. The key seems to be the relevance of the cues to the learning task. For example, using a photograph of a car engine to teach about the location of the carbeurator might be appropriate in terms of relevant cues, whereas the same photograph would be inappropriate to teach about the structure and function of the carb itself.

Joseph and Dwyer (1982) concluded that the integration of realistic and abstract graphics may reduce achievement differences between students of different ability levels. This appears to interact with the concreteness or abstractness of the topic to be learned. In teaching about computers, for example, the parts of a computer can be highly concrete and easy to represent graphically, while the functions of a computer are quite abstract and therefore not as conveniently represented.

Rigney and Lutz (1976) elaborated effects of graphics in instruction by urging students to form mental images as they studied the material. Increased learning resulted from this combination. These results are supported by the research of Canelos (1979) who showed that training in visual imagery techniques resulted in better learning on a highly visual but real-world memory task.

Another factor about graphics needs to be considered for both research and learner evaluation. The amount learned from instruction using graphics can be suppressed and appear not to have been learned if the examination does not contain the graphics stimuli that were present during learning. Szabo, DeMelo & Dwyer (1981) showed that achievement scores were significantly higher when the graphics used during instruction were incorporated into the testing protocol.

Animation does not have the rich research history that is associated with color and graphics. This may be due to the fact that until recently, creation of animation required mainframe computers with complex software and high skill levels. Today, basic animations can be created using micros and relatively inexpensive and easy to use software. Furthermore, today's computers are capable of high resolutions of 72 pixels per square inch, 24 bit color (14M colors), and 30 frames per second video. While the realism provided by the new technology seductively implies increased learning effectiveness, prior research results showing the superiority of simple graphics should make us cautious about assuming effectiveness.

In an early study using movies to provide animation, motion was shown to be superior to slides or sequential photos in presenting time- and motion-based concepts (Wells, 1973). The reverse was true for concepts involving the presentation of spatial entities.

Baek and Layne (1988) compared learning conditions of text only, text plus graphics, and text plus animation. The adults in the study scored higher in the animation condition than either text or graphics. The animation condition also resulted in less study time, suggesting that animation results in more efficient learning. In another study with adult learners, Mayton (1991) found increased scores in the animation condition immediately after study persisted and were measurable one week later.

Rieber and Boyce (1990) compared animation-based instruction with carefully designed verbal presentations which used highly imaginative examples and illustrations. The results with an adult sample indicated no significant difference in the amount learned but the animation group required less time to retrieve the information they learned. One would have to ask whether the results would follow with children who may not have sufficient experience bases to accurately imagine the examples and illustrations used.

It remains to be seen whether the gains in learning or reductions in learning time that animation seems to offer are worth the added time and energy needed to create animations, compared with other forms of instruction such as mental imagery and visual elaboration.

A RECENT STUDY COMPARING ANIMATION, GRAPHICS AND TEXT

Goal of the Study

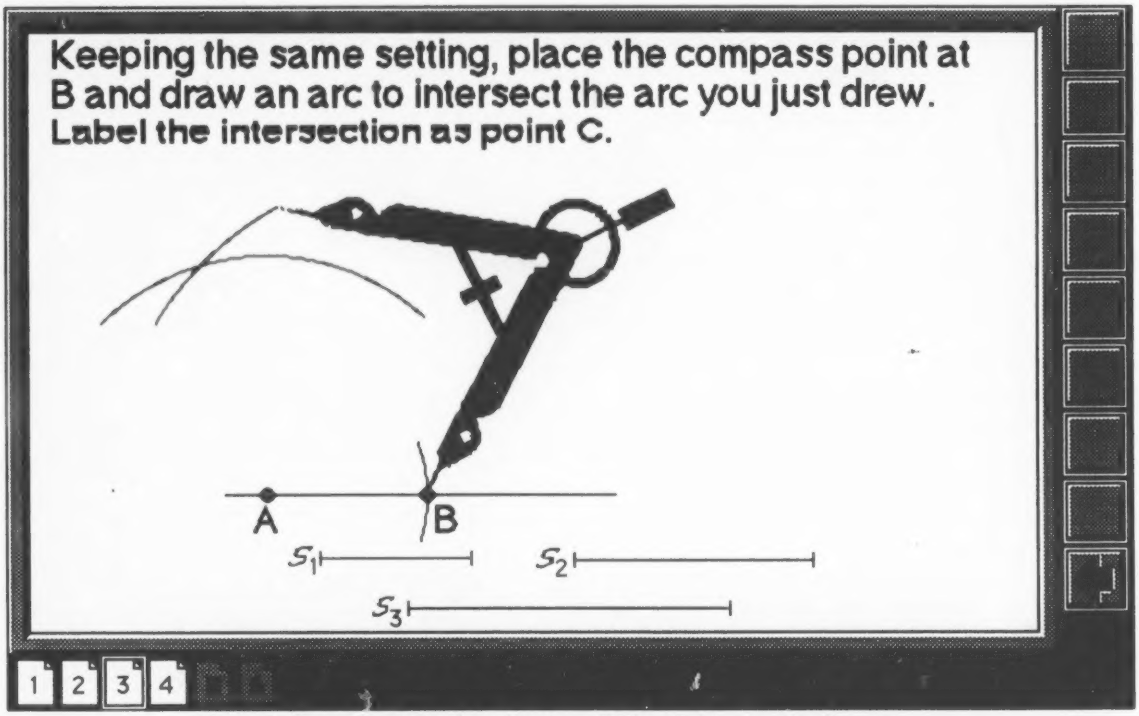
The authors recently completed a comparison of animation, still graphics, and text only on the acquisition of the mathematics skill of using a compass to create triangles and attitude toward the instruction (Poohkay, 1994). It was hypothesized that animation would result in greater achievement of the learning task, followed by graphics, and lastly text would yield the lowest achievement. The same hypotheses were posed for attitude toward mathematics instruction by computer. The instruction was delivered by computer based instruction.

Materials and Methods

The instruction used a single lesson from a larger, grade 10 mathematics curriculum designed for distance delivery. The objective of the lesson was to be able to use a compass to create triangles from given line segments. Three versions of the lesson were developed and differed only in their use of graphics. The animation lesson included several animations of the process of constructing triangles with a compass. The graphics version replaced the animations with a series of static graphics. The text-only version used no graphics at all. See Figures 1 and 2 below for the graphics and text versions, respectively. (The animation sequence will be demonstrated as part of the formal presentation of this paper)

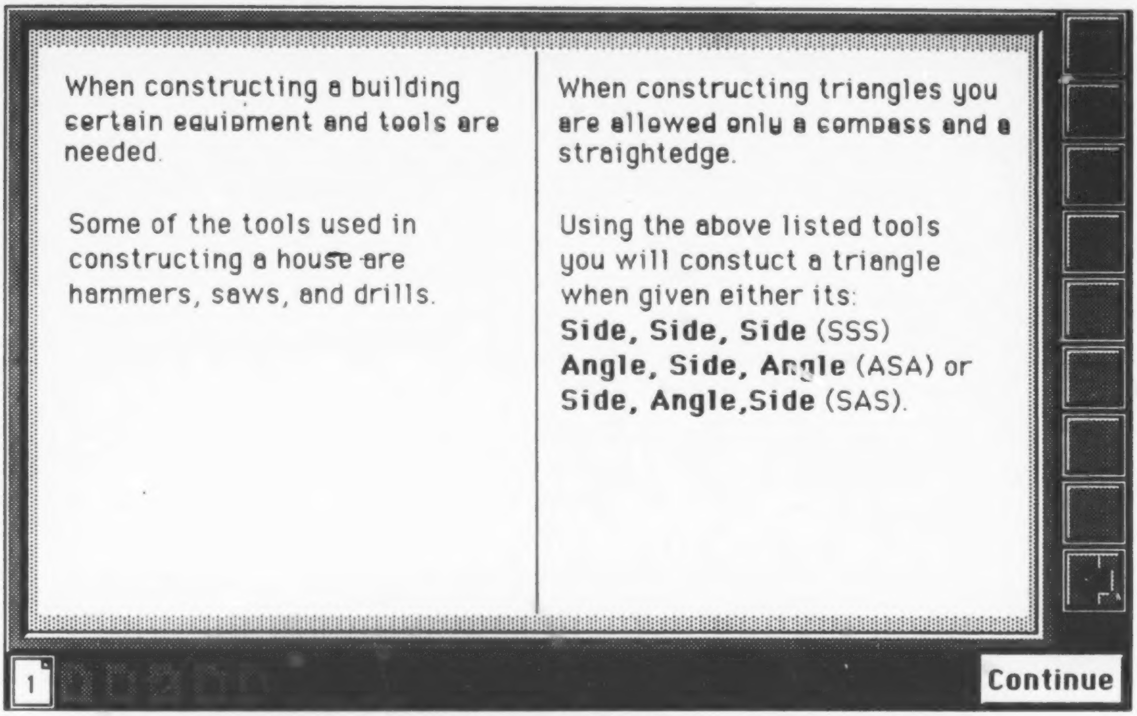
Lessons were developed using Authorware Professional for the Macintosh and delivered on a network of Macintosh IIci s. The sample of 147 volunteers was drawn from a group of undergraduate elementary education majors who were completing a required course in elementary mathematics teaching methods.

One hundred percent of those approached agreed to participate in the study which was conducted during one scheduled class period. Upon entering the computer lab, students completed an informed consent form and a mathematics skill pretest. They were then randomly assigned to the instruction using one of the three instructional methods noted above. As they completed the lesson, they were tested on their ability to draw several triangles using compasses provided by the researchers. Finally, they completed a Likert-type scale which assessed attitude toward mathematics instruction by computer.



Keeping the same setting, place the compass point at B and draw an arc to intersect the arc you just drew.
Label the intersection as point C.

Figure 1. Example of Graphics Version of Triangle Construction Lesson


When constructing a building certain equipment and tools are needed.

Some of the tools used in constructing a house are hammers, saws, and drills.

When constructing triangles you are allowed only a compass and a straightedge.

Using the above listed tools you will constuct a triangle when given either its:
Side, Side, Side (SSS)
Angle, Side, Angle (ASA) or
Side, Angle,Side (SAS).

Figure 2. Example of Text Version of Triangle Construction Lesson

Achievement and Attitude Findings

As predicted, students who studied the animated lesson scored significantly higher than those using the graphics lesson who in turn scored significantly higher than those using the text only version. Table 1 presents the ANOVA summary table and means scores.

Table 1. ANOVA Summary Table and Mean Achievement Scores of Treatment Groups

Source	d.f.	Sum of Squares	Mean Squares	F- Ratio	Probability
Between Groups	2	3890.73	1945.36	32.34	< 0.00
Within Groups	170	10226.66	60.16		
Total	172	14117.39			

Treatment	Mean	Standard Deviation	Cases
Text	6.9	5.8	59
Graphics	11.4	8.1	57
Animation	18.4	9.1	57
Total	12.15	9.1	173

When the criterion was attitude toward mathematics instruction by CBI, the animation group had significantly higher attitude scores than the text group and equivalent scores to the graphics group (Table 2). Attitude was defined by a Likert-type scale designed to measure attitude toward the learning of mathematics by CBI.

Table 2. ANOVA Summary Table and Mean Attitude Scores of Treatment Groups

Source	d.f.	Sum of Squares	Mean Squares	F- Ratio	Probability
Between Groups	1	550.12	550.12	6.93	< 0.01
Within Groups	171	13567.27	79.34		
Total	172	14117.39			

Treatment	Mean	Standard Deviation	Cases
Text	72.5	13.1	59
Graphics	79.4	11.5	57
Animation	79.8	11.0	57
Total	77.2	12.3	173

Recommendations for the Use of Graphics and Animation

Several recommendations serve as useful guidelines for the use of graphics and animation in CBI. These recommendations stem from the research literature and study cited above, supplemented by the personal experience of the authors.

1. Analyze the relevance of graphics/animation cues to the learning outcome and use those cues appropriately in the instructional, practice, and testing situations relative to the particular learning objectives.

2. Opt for graphics in animations which are simpler in design to optimize learning.

3. Examine graphics/animations for these criteria
   a. sense of perspective, e.g., relative size, speed, and path of motion
   b. ability to convey the time- or motion-based aspects of animation in a single viewing, alternatively provide the learner with multiple opportunities to replay the animation.
   c. clarity of representation, which may be effectively enhanced by the use of text labels
   d. the desirability of showing the animation from multiple perspectives.
   e. the ability of the learner to interact with and modify the graphic/animation.

4. Seek the advice/development expertise of a graphics/animation specialist.

5. Test out prototype lessons using different graphics/anmations with your target population of learners.

6. Test prototype lessons on the complete range of target delivery machines. Various machines are capable of different speeds of running the animation or drawing the graphic and give rise to different effects which can be quite different from that intended.

7. Complex animations may not be optimal for beginning learners (Rieber, 1990).

8. The real contribution of animation may be in the realm of interactive graphics (Siliasukas, 1986). However, few have been constructed for general education due to the enormous complexity and expense involved.

9. Enhance the encoding power of graphics or animations by engaging the learners in the creation and use of mental imagery during instruction.

10. Enhance the decoding power of graphics or animations by using the same graphics and animations in testing situations as were used in the instruction.

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CONCLUSIONS

The substantial amount of research conducted to determine effects of graphics on learning suggests a high level of effectiveness for graphics. Beyond thes generalization there are specific situations in which use of graphics must be carefully planned. Comparatively much less research has been conducted with regard to animation as an instructional tool. Based on results to date, one might conclude that animation has a positive and significant effect upon learning outcomes.

Whatever media are used, it is recommended that one carefully analyze the relevant, irrelevant, and counterproductive cues of any learning task and create or select media which strike a proper balance relative to those cues.

Consider the nature of the target population of learners relative to the media chosen in terms of ability, experience, or maturity level.

Recognize that media has the potential to add significant visual appeal to instruction but that visual appeal is not known to be correlated to instructional effectiveness. At the same time significant visual appeals sells products.

Consider enhancing learning by combining media with non-media instructional methods to optimize learning. For example, the use of icons to convey complex symbols is often subject to misinterpretation, which can be easily eliminated by addition of simple text. The use of graphics and animation may be enhanced by incorporating procedures and training in the use of visualization techniques.

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Title:

A Comparison of On-Line and Traditional Paper and Pencil Notetaking Methods During Computer-Delivered Instruction

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Abstract

Readily accessible computer technologies including on-line notepads provide new environments for notetaking research. Findings from this study indicate that taking notes from CBI using an on-line notepad: promotes greater achievement than pencil and paper methods; is preferred by learners who report higher confidence ratings towards new technologies; and promotes minimal recording of the learner's own thoughts.

Prior to the paradigmatic shift towards cognitivism in the mid 1970's, the significance of notetaking was openly challenged. Gagne' states in the 1970 addition of his text *The Conditions of Learning* that "Most (students) may be taking notes, which as far as anyone knows is an entirely useless activity quite unrelated to learning." Gage and Berliner in their 1975 publication of *Educational Psychology* suggest that "Notetaking may be effective only when a student's short term memory is relatively high." Despite of comments like this, learners have been encouraged for decades to take notes during lectures and from readings and to use them as a source of review (Hartley and Davies, 1978).

The movement towards cognitivism was significant because it shifted the focus to the learner's cognitive state and processing strategies as the primary determiners of learning. Wittrock's generative model of learning sought to summarize the constructive processes between the individual and stimuli required for learning. According to Wittrock's model, when a motivated learner is presented with a stimulus (lecture material, text readings, illustrations, etc.), the learner constructs and assigns meaning to it based on prior learning. Previously learned information used in constructing meaning for the stimulus may consist of rules, algorithms, schemata, or image or verbal memories of specific experiences. The goal of this construction process is to form associations. The more associations that the learner can establish between the stimulus and previously learned material, the more meaning the stimulus has associated with it, thus providing a better chance for it to be encoded into memory (Wittrock, 1974, 1978).

It is at this point, when the learner is actively engaged in building associations between what is known and that which is to be interpreted, that the inherent value of notetaking as a generative learning activity becomes apparent. Generative activities such as cognitive mapping, generating questions or mnemonic memory aids, underlining. paraphrasing, summarizing, and notetaking require the learner to knowingly and intentionally relate new information to their knowledge rather than passing over or responding to material without personal intervention.

The merits of notetaking can be viewed from two different perspectives: as a facilitator for encoding information into memory or as an external storage medium to enhance review of the subject matter (Di Vesta & Gray, 1972). The encoding hypothesis implies that notetaking is an individual task through which learners can actively integrate and elaborate upon what they hear, see, or read with their prior knowledge. Once generated, the external storage hypothesis posits that the notes themselves function as a review tool, a form of external storage device.

The majority of research studies on notetaking to date have utilized live-lecture situations and conclude that notetaking facilitates learning either through encoding or external storage or a combination of both (Hartley, 1983, Ladas, 1980, Henk & Stahl, 1985). Only a limited number of studies involving notetaking from text, films, and television exist (Hartley, 1983). Research conducted utilizing text suggests that the encoding function of notetaking is most significant (Barnett, Di Vesta, & Rogozinski, 1981, Bretzing & Kulhavy, 1979, Rickards & Friedman, 1978) The limited number of studies done using films and television offered no insight as to the function of notetaking. No research was located which utilized the computer as either a medium used to record notes or as a source from which notes were generated.

Looking forward, past the pencil and paper used in traditional notetaking research, are readily accessible computer technologies including on-line notepads, window environments, and notebook sized computers which provide new environments for notetaking research. The computer technology which facilitates notetaking research in and of itself is of little interest; rather it is the cognitive effects of these technologies on the intellectual performance of the learner that is significant (Salomon, Perkins, & Globerson, 1990).

This study sought to describe the effects of technology on the notetaking strategies and behaviors of university students. More specifically, the following questions were addressed in this study: (1) Given a choice, do students prefer taking notes from a computer tutorial using pencil and paper or the computer itself? (2) Is there a relationship between the subject's confidence level towards using computer related technology and the method of notetaking selected? (3) Does the method of notetaking affect time on task or achievement? (4) Does the content of the notes (word count, percent of information copied, and percent of main ideas) differ significantly between students who used pencil and paper to take notes and those that used a computer?

Method

Subjects

A student profile questionnaire was administered at a university in southern Minnesota to 104 undergraduates whose major or minor was computer science. Computer science majors and minors were selected for this study because their discipline required significant time utilizing computer technology, thus assuring adequate experience with computers prior to the study. Only students who indicated they had worked extensively with microcomputers and word processing applications, and had no prior knowledge of the technical aspects of IBM's AS/400 minicomputer system were eligible for selection. Based on these criteria, 76 subjects participated in this study. Of this group, 61 had a class rank of senior and 15 had a rank of junior.

Materials

Tutorial. Over a period of five weeks, participants used either pencil/paper or a computer to generate notes while reviewing selections from IBM's AS/400 minicomputer on-line tutorial. The tutorial modules used in this study were: Introduction to the Operating System; Operating System and Architecture Support; Equipment Overview; Control Language Structure; Attachment of Personal Computers and Other Devices. No time limit was placed on viewing the modules.

On-line notetaking pad. The tutorial modules were accessible over a network configuration which allowed the participants to simultaneously view a module and access the on-line notetaking pad with a single keystroke. The computer notetaking pad consisted of a scrolling window that had the same formatting, editing, printing, and copy/paste capabilities as a word processor. The notepad was also dynamic; it could be sized and repositioned on the screen at any time.

Submission of notes. Each week, after the notes were submitted, the method used by each subject to take notes was recorded. In addition, the notes from randomly selected subjects from both groups were evaluated weekly for word count, percentage of copied information, and percentage of main ideas.

Post test. The achievement posttest consisted of fifteen question: seven multiple and seven fill in the blanks. The questions included recall, application and synthesis questions. Subjects were not allowed to review their notes prior to the test. The KR-20 reliability for this test was .71.

Exit questionnaire. This instrument consisted of open ended questions which sought to determine why a participant selected their dominate method of notetaking. Additionally, it served as a self report method to elicit the amount of time spent viewing and taking notes per module.

Procedures

Subjects were selected for the study based on their responses to key questions on the prestudy student profile questionnaire. Prior to the study, all subjects selected for the study participated in a two hour training session. The study required each participant to review and take notes using either pencil and paper or the on-line notepad from one tutorial module each week for five weeks. All notes were monitored weekly for the notetaking method used. In addition, randomly selected notes from both the pencil and paper and on-line notepad group were evaluated weekly for word count, percentage of copied information and percentage of main ideas. After the submission of the last weeks' notes, each student completed an achievement posttest and completed an exit questionnaire. Subjects completed all work on their own time and were given extra points equivalent to ten percent of their grade in one computer science class during the quarter of the study.

Training. Each subject took part in a two hour training session designed to: (1) review the criteria and benefits of good notes regardless of the medium; (2) define the objectives for each module used in the study; (3) provide hands-on experience accessing the AS/400 tutorial modules and on-line notepad. During the session participants were also instructed that at any time during the study they could select the alternate notetaking method.

Selection of Subjects for Weekly Monitoring. In addition to each participant's method of notetaking being recorded weekly, notes taken by subjects from both groups were randomly selected for weekly evaluation. After the first week's notes were submitted, four subjects (23.5 percent) who used pencil and paper and 12 (22 percent) who used the on-line notepad for notetaking were randomly selected for weekly monitoring during the entire study. Interestingly enough, each monitored participant used the same method selected for notetaking the first week throughout the remainder of the study. Also, an additional five subjects from the pencil and paper group and 12 from the on-line notepad group were randomly selected each week for weekly monitoring. Thus, the notes from approximately 44 percent of the study's participants were evaluated weekly for word count, percent of copied material, and percent of main ideas.

Reliability of Random Evaluation Scoring . Prior to the beginning of the study, this author and a graduate research assistant in computer science reviewed each of the topics in the tutorial used in the study and each compiled an set of 'ideal' notes about the topics. Agreement was easily reached regarding the main ideas presented in each tutorial module. A printout which contained the text, diagrams, and questions found in the tutorial was made available to each reviewer.

Scoring reliability for the participants' notes' word count, percentage of main ideas, and percentage of information copied, was estimated by having both reviewers score a sample of notes taken on the same topic from the pencil and paper and on-line notepad groups. Using this method, we were able to ensure that the notes selected for review on any given topic were scored by two people. For the sets of notes used in the reliability check, disagreements were resolved by rechecking the notes and discussion. Based on the review of 75 sets of notes, the average percent of reviewer agreement was: 95.4 percent for word count, 98.3 percent for percent main ideas, and 96 percent for percent of information copied.

Dominant Notetaking Method. At the conclusion of the study, subjects were assigned, for statistical calculations, to one of three groups (pencil/paper, on-line, or combination of both methods) based on the dominate method used to record their weekly notes. To be placed in either the pencil/paper or on-line group, students must have selected that method for four or more weeks. All but three students participating in the study were originally assigned to one of these two groups. In other words, it appeared that once a subject selected a method to record notes, that method was used consistently throughout the study. Because of their limited number, the three subjects who comprised the third group were not used in the statistical calculations.

Posttest and exit questionnaire. Upon reviewing the five tutorial modules, subjects completed an achievement test and the exit questionnaire.

Data Analysis. Statistical calculations were carried out using SPSSX software. Significance level was set at $p = .05$.

Results

Achievement

Means and standard deviations for the posttest scores are given in Table 1. The on-line notetakers (M = 7.04) performed better on the post test than those using pencil and paper (M = 5.29). One way ANOVA results revealed that the difference between the post test means were significant [F(1,71) = 4.519, $p = .037$]. Two-way ANOVA results yielded no significant main effect for major or minor [F(1,69) = 1.934, $p = .169$] or the type of notetaking method [F(1,69) = 2.244, $p = .139$]. The interaction effect was not significant [F(1,69) = .463, $p = .498$].

Table 1: Means and Standard Deviations for Achievement

Group	N	Mean	SD
Pencil/paper	17	5.29	2.17
On-line notepad	56	7.04	3.15

Subjects' Use of Notetaking Methods

The number of subjects and the percentage of computer science majors and minors who used pencil and paper or on-line notepad as their dominate notetaking method is shown in Table 2. As previously described, subjects were assigned to a notetaking group based on their weekly notetaking method.

Table 2. Composition of Notetaking Groups

Group	N	Percent of Total	Percent of Group Total	Percent of Major/Minors
Pencil/paper	17	23.29		
Computer science majors	4		23.53	9.3
Computer science minors	13		76.47	43.3
On-line notepad	56	76.71		
Computer science majors	39		64.29	90.7
Computer science minors	17		30.36	56.7

Attitudes

Several Likert-type items on the prestudy student profile questionnaire were used to assess the subjects' confidence working with computers, word processors, and other new technologies. The means and standard deviations for these questions are presented in Table 3. The ranking scale consisted of the value five associated with low confidence rating and the value one associated with a high confidence rating. The on-line notetakers responded consistently more positively towards using computers and technologies than the pencil and paper group.

Table 3: Means and Standard Deviations for Attitude Scored Associated with Using Computers and Other Technologies

	Groups			
	Pencil/Paper (N=17)		On-Line Notepad (N=56)	
Questions	Mean	SD	Mean	SD
Use of microcomputers	1.65	.71	1.29	.60
Use of word processors	1.88	.86	1.36	.65
Use of computer related technologies	2.53	1.01	1.48	.69
Acceptance of new methods to perform tasks	2.59	1.06	1.76	.77
Adjust to using new technologies	2.47	.87	1.60	.78

One-way ANOVA results from follow-up comparisons between the mean scores revealed that the differences between the means for each question were significant: (use of microcomputers [F(1,71) = 4.23, $p = .04$]; use of word processors [F(1,71) = 7.09, $p = .01$]; use of computer related technologies [F(1,71) = 23.48, $p < .01$]; acceptance of new methods to perform tasks [F(1,71) = 12.35, $p < .01$; adjust to using new technologies [F(1,71) = 15.16, $p < .01$]).

In the exit questionnaire, subjects were asked to rank possible reasons for selecting their dominate notetaking method used during the study. A ranking of one indicated that it was the most important reason for selecting the method while the rank of six signified it was the least important. Reasons that were marked as not important in the decision making process were not included in the calculations. The means and standard deviations for each possibility are given in Table 4. Students selected the on-line notepad because of the speed and the ease of reading the notes once recorded. It appeared the other group viewed the pencil and paper as the easiest way to record their thoughts.

Table 4: Means and Standard Deviations for Reason for Selecting a Notetaking Strategy

	Groups			
	Pencil/Paper (N=17)		On-Line Notepad (N=56)	
Reasons	Mean	SD	Mean	SD
Faster method to record notes	3.77	.62	1.62	.20
Notes easier to read, study froma	4.86	.57	2.96	.26
Easiest way to record thoughts	3.22	.48	4.60	.30
Better environment to learn from	4.82	.50	4.40	.28
Used to working in a window environment	4.50	.53	4.79	.31
Not worked with an electronic notepad before	4.91	.56	5.51	.36
Not worked on the AS/400 computer system before	5.91	.69	5.94	.34

Time on Task

Subjects were asked on the exit questionnaire to estimate the time spent reviewing and recording notes for each of the modules. The means and standard deviations for the average time spent per module is reported in Table 5. A follow-up one-way ANOVA indicated no significance between the means of the two groups [F(1,71) = .03, *p* = ..87].

Table 5: Means and Standard Deviations for Time on Task

Group	N	Mean	SD
Pencil/paper	17	39.99	15.91
On-line notepad	56	39.32	13.82

Word Count, Percent Information Copied and Percent Main Ideas

The monitored subjects using the on-line notepad had significantly higher word counts, percentage of copied material, and percentage of main ideas than those using pencil and paper. The means and standard deviations for word count, percent information copied, and percent of main ideas for the groups monitored weekly are given in Table 6. More information was copied directly from the tutorial by the group using on-line notepad (M = 90.12 percent) than by the pencil/paper group (M = 46.17 percent). This may have accounted for the higher word count associated with the on-line notepad group. The notes from the on-line group also contained more main ideas (M = 86.63 percent) than the pencil/paper group (M = 72.75 percent).

Table 6. Means and Standard Deviations for Parameters Monitored Weekly

Parameter	Grouping	N	Mean	SD
Word Count				
	Pencil/Paper	13	175.67	132.94
	On-line notepad	43	341.60	179.72
Percent Copied				
	Pencil/Paper	13	46.17	24.37
	On-line notepad	43	90.12	15.89
Percent Main Ideas				
	Pencil/Paper	13	72.75	31.07
	On-line notepad	43	86.43	16.19

One-way ANOVAS revealed differences between the pencil and paper and on-line notepad group on the following parameters: average word count [*F* (1,54) = 8.799, *p* = .005, percentage of notes copied [*F* (1,54) = 55.517, *p* < .000], percent main ideas [*F* (1,54) = 4.25, *p* = .04].

Discussion

This study examined the following: if one method of notetaking promoted a higher level of achievement; if students favored taking notes from a computer tutorial with a microcomputer or pencil and paper; and if the content and structure of the notes differed between platforms used to record notes.

Results of this study show that taking notes using the on-line notepad is the most effective method of notetaking, as assessed by the post test, regardless of whether the participant's major or minor is computer science. It appears that the ability to copy and paste text as well as generating notes provides an environment which promotes more achievement than traditional pencil and paper methods.

Results of this study showed that subjects preferred using the on-line notepad rather than traditional pencil and paper. An overwhelming percentage of computer science majors and approximately half of the minors consistently used the on-line method to record notes. Participants who selected the on-line method reported higher confidence ratings towards using microcomputer, word processors and new technologies than those using pencil and paper. This discounts any suggestion that a novelty effect may have been associated with the use of the on-line notepad. Instead, these finding indicate that the more confident the subjects were with using the technology, the more it was utilized.

The results of the present study also revealed that notes taken by the on-line group consisted mainly of text that was copied from the tutorial and pasted to the notepad while the notes generated by the pencil/paper group reflected more of their own thoughts. The copy and paste strategy employed by the on-line group may have impacted the group's word count and percent of main ideas tabulations as well.

As previously enumerated, an important criterion used by both groups to select a notetaking method was how quickly notes could be recorded utilizing the method. When examined, no significant difference was found between the two groups' average time per module spent reviewing and taking notes.

As computer related technologies evolve, current images are redefined; books have become disks and pencils have been transformed into keyboards and mice. Although it is tempting, our primary attention should remain focused on the programs and tools which can be used with the technology and the activities they afford.

In order for the computer to function as a tool to enhance cognition, an individual must seek to develop an intellectual partnership with technology. As demonstrated in this study, the strength of the partnership relies heavily on how confident the individual is in using the technology, and whether the activities promoted by the technology encourage active, mindful engagement on the part of the learner.

As technology advances, its benefits may not be realized automatically. Further research should focus on the development and evaluation of activities, situations, and computer applications specifically crafted to promote engaging partnerships between the learner and the technology. Research should also focus on how cognitive effects, such as the development of problem solving strategies arrived at through such partnerships, can become more transferable to situations which do not involve technology.

Specific to this study, there are five areas which merit further investigation. First, identify the cognitive strategies employed by students who prefer using an on-line notepad for notetaking. Second, assess whether the on-line method of notetaking is as beneficial when students are not allowed to use the copy/paste function but rather must generate original notes. Third, examine whether the learner's familiarity with the content of the tutorial impacts the method of notetaking selected or the amount of material copied directly from the tutorial and placed in the notes. Fourth, identify the preferred notetaking method of learners form other discipline areas and grade levels. Fifth, examine the relationship between using technology to generate notes over an extended period of time and the process and product functions of notetaking.

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Title:

Questioning the Questions of Instructional Technology Research

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My First Flame

In April 1994, I was "flamed" on the Internet, a '90s phenomenon that has been portrayed in publications as diverse as *The New Yorker* (Seabrook, 1994) and *The Chronicle of Higher Education* (Lemisch, 1995). Although what exactly constitutes a "flame" in the rapidly evolving "metaverse" (Stephenson, 1993) is a matter of much debate, I can vividly recall the feelings of shock and anger that swept through me when I read the note calling me a "jerk" on a "listserv" shared by hundreds of members around the world.

It all began last spring when I read two queries from doctoral students on the Qualitative Research for the Human Sciences listserv <QUALRS-L@uga.cc.uga.edu>. Both students came from large public institutions of higher education, one in the USA and the other in Canada. The first student wrote that she intended to focus her dissertation research on the quality of "discourse" that takes place in cafes and coffee shops located inside bookstores. She complained that she had found no "literature" on this topic and asked the listserv participants for some guidance. The second student announced that he was preparing a dissertation prospectus centered on the question of how people learned about opportunities to take SCUBA diving lessons and what motivated them to register for such courses. He also sought directions to relevant literature and advice from the listserv membership.

After pondering these queries, I posted a message asking whether faculty members at taxpayer-supported universities have a moral responsibility to guide their students toward "socially responsible" research questions. In my posting, I suggested that in the face of problems such as adult illiteracy, attacks on public education, "at-risk" students, homelessness, AIDS, and the like, faculty members should attempt to inspire in students a dedication to research that would "make a difference."

Soon after posting my note, the graduate student who had sought help with his SCUBA query "flamed" me with his "jerk" note in which he went on to criticize my "attack" on his freedom to address whatever research questions interested him, especially given he was a taxpayer as well. A small grass fire of flames then erupted as several listserv members castigated the student for calling me a jerk, some agreed with my critique, and others defended the perspective that the social relevance of doctoral dissertation research (or any educational research) was irrelevant. No resolution of this issue was reached on the listserv, but I was especially impressed by the response of an education professor from a large land grant university in the USA who agreed with my criticism, but went on to suggest that much of the research he has read in the field of instructional technology could be subjected to a similar critique. This prompted me to ponder the social relevancy of research in our field.

Is Instructional Technology Research Socially Relevant?

Social relevance is an issue that is obviously subject to much debate. One's age, race, gender, socioeconomic status, education, religion, political allegiance, and many other factors are likely to influence one's interpretation of the social relevance of any given research study. Nevertheless, for the sake of this analysis, I will attempt to define social relevance with respect to scientific inquiry. My definition is based upon the following principles that guide scientific research (derived from Casti, 1989):

- Science is an ideology that consists of a cognitive structure concerning the nature of reality together with processes of inquiry, verification, and peer review.
- Views of reality differ according to one's philosophy of science, e.g., realism maintains that an objective reality exists, instrumentalism asserts that reality is the readings noted on measuring instruments, and relativism claims that reality is what the community says it is.
- Scientific research is a social activity that has certain standards and norms, e.g., it should not intentionally harm humans and it must be able to be replicated by other researchers.
- Socially responsible research in education adheres to the basic principles listed above while at the same time it addresses problems that detract from the quality of life for individuals and groups in society, especially those problems related to learning and human development.

In the view of some, instructional technology research might lay claim to a blanket *imprimatur* with respect to being "socially responsible." After all, at some level, all instructional technology research can be said to focus on questions of how people learn and perform, especially with respect to how learning and performance are influenced, supported, or perhaps even caused by technology. As long as research is focused on learning and performance problems, and adheres to the principles listed above, it would seem to be socially responsible.

Others in the research community argue that concern for the social responsibility of research in instructional technology or any other field is ludicrous. They maintain that the goal of research is knowledge in and of itself, and that whether research is socially responsible is a question that lies outside the bounds of science (cf., Carroll, 1973). In my experience, researchers in the natural sciences such as biology and chemistry do not often concern themselves with the relevance question, but this is a debate that has raged for decades among educational researchers (see Note 1). For example, as reported by Farley (1982), Nate Gage, a past president of the American Educational Research Association (AERA), has been a staunch defender of the notion that the goal of basic research in education is simply "more valid and more positive conclusions" (p. 12) whereas another past president of AERA, Robert Ebel, proclaimed:

> ....the value of basic research in education is severely limited, and here is the reason. The process of education is not a natural phenomenon of the kind that has sometimes rewarded scientific investigation. It is not one of the givens in our universe. It is man-made, designed to serve our needs. It is not governed by any natural laws. It is not in need of research to find out *how* it works. It is in need of creative invention to *make* it work better. (p. 18, Ebel's italics).

In my opinion, Ebel's stance (with which I agree) is directly relevant to the issue of socially responsible research in instructional technology. There is little social relevance in research studies that are largely focused on understanding "how" instructional technology works without substantial concern for how this understanding makes education better. On the other hand, there is considerable social relevance in I.T. research studies that are largely focused on making education better (and which in the process may also help us understand more about how instructional technology works).

Most of the research in instructional technology is grounded in a "realist" philosophy of science, i.e., conducted under the assumption that education is part of an objective reality governed by natural laws and therefore can be studied in a manner similar to other natural sciences such as chemistry and biology. If this assumption about the nature of the phenomena we study is erroneous (and I believe it is), then we inevitably ask the wrong questions in our research. Further, even if there are underlying laws that influence learning, the complexity inherent in these laws may defy our ability to perceive, much less control, them (Casti, 1994). As Cronbach (1975) pointed out two decades ago, our empirical research may be doomed to failure because we simply cannot pile up generalizations fast enough to adapt our instructional treatments to the myriad of variables inherent in any given instance of instruction.

Of course, I am not the first person to express concerns about the nature of research in instructional technology. I adopted the title of this paper from one published twenty-seven years ago by Keith Mielke (1968) titled "Questioning the Questions of ETV Research." Other critics of the questions and methods of research in instructional technology include Lumsdaine (1963), Schramm (1977), Clark (1983), and Salomon (1991). The debate about the nature of reality and the conduct of research in our field continues as evidenced by the recent spate of articles focused on the question of "Does media influence learning?" (Clark, 1994a, b; Jonassen, Campbell, & Davidson, 1994; Kozma, 1994a, b; Morrison, 1994; Reiser, 1994; Ross, 1994a, b; Shrock, 1994; Tennyson, 1994; Ullmer, 1994). However, few critics have dealt directly with questions of whether instructional technology research is, can be, or should be socially responsible. That is the purpose of this paper.

The State of Instructional Technology Research

Before returning to the issue of the social relevance of instructional technology research, it is necessary to examine the state of research in the field today. To accomplish this, I reviewed the contents of two of the primary research journals in the field, the *Educational Technology Research and Development* (ETR&D) journal and the *Journal of Computer-based Instruction* (JCBI) over the periods 1989-94 for ETR&D and 1988-93 for JCBI (see Note 2).

For this review, I originally intended to use a research article classification scheme developed by Dick and Dick (1989) (see Figure 1), but my initial attempts to categorize articles using that scheme led to several difficulties, especially in terms of classifying studies that were primarily interpretivist in intent and naturalistic in method, e.g., Neuman (1991).

Literature review	a summary of a body of literature, sometimes as a critique and sometimes as a statement of the state of the art.
Methodological article	a new model or procedure for carrying out a technical activity.
Theoretical article	one which primarily draws upon and contributes to the theoretical literature of the field.
Empirical and experimental studies	all studies, other than evaluations, which use data in order to draw conclusions.
Descriptive study	a presentation of information about a particular program or event, with little or no use of data.
Evaluation study	a presentation of data and information to describe the effectiveness of a particular program or method, usually in an applied setting.
Professional article	a description of topics dealing with the profession of instructional technology, such as determination of competencies or descriptions of internship programs.

Figure 1. Research article classification scheme from Dick and Dick (1989).

After reflection and consultations with several research experts, I modified the classification scheme (see Note 3) This new classification scheme represents an effort to distinguish between the goals of research and the methods of research. First, I propose that most research studies in instructional technology can be classified according to the six research goals represented in Figure 2. This scheme is partially based upon discussions of research "paradigms" that have dominated educational research literature in recent years. For example, according to Soltis (1992), there are currently "three major paradigms, or three different ways of investigating important aspects of education" (p. 620) used in educational research: 1) the positivist or quantitative paradigm, 2) the interpretivist or qualitative paradigm, and 3) the critical theory or neomarxist paradigm. Although the "paradigm debate" literature is fascinating, I do not feel that the three categories presented by Soltis (1992) and others (e.g., Schubert & Schubert, 1990) capture the full breadth of research goals in the field of instructional technology. At the same time, there may be other goals of inquiry that are not be included in this scheme.

Theoretical	research focused on explaining phenomena through the logical analysis and synthesis of theories, principles, and the results of other forms of research such as empirical studies.
Empirical	research focused on determining how education works by testing conclusions related to theories of communication, learning, performance, and technology.
Interpretivist	research focused on portraying how education works by describing and interpreting phenomena related to human communication, learning, performance, and the use of technology.
Postmodern	research focused on examining the assumptions underlying applications of technology in human communication, learning, and performance with the ultimate goal of revealing hidden agendas and empowering disenfranchised minorities.
Developmental	research focused on the invention and improvement of creative approaches to enhancing human communication, learning, and performance through the use of technology and theory.
Evaluation	research focused on a particular program, product, or method, usually in an applied setting, for the purpose of describing it, improving it, or estimating its effectiveness and worth.

Figure 2. Research goal classification scheme.

Second, given the aforementioned desire to separate the goals of research studies from the methodologies employed in them, I propose the methodology classification scheme represented in Figure 3. Of course, there are numerous methods available to researchers in instructional technology (cf., Driscoll, 1995), but for the sake of simplicity, these five methodological groupings provide sufficient discrimination to allow the analysis represented below.

Quantitative	experimental, quasi-experimental, correlational, and other methods that primarily involve the collection of quantitative data and its analysis using inferential statistics.
Qualitative	observation, case-studies, diaries, interviews, and other methods that primarily involve the collection of qualitative data and its analysis using grounded theory and ethnographic approaches.
Critical Theory	deconstruction of "texts" and the technologies that deliver them through the search for binary oppositions, hidden agendas, and the disenfranchisement of minorities.
Literature Review	various forms of research synthesis that primarily involve the analysis and integration of other forms of research, e.g., frequency counts and meta-analyses.
Mixed-methods	research approaches that combine a mixture of methods, usually quantitative and qualitative, to triangulate findings.

Figure 3. Research methods classification scheme.

The combination of the goal classification and the methods classification schemes yields a matrix of research goals by research methods. Figure 4 presents my analysis of the research articles published in ETR&D (1989-1994). There were one hundred and four articles published in the research section of ETR&D in the six years from 1989 through 1994 (see Note 4). Not every article could be classified according to the classification matrix illustrated in Figure 4. Six "methodological articles" (presenting a new method or procedure for carrying out research) and three "professional articles" (analyzing the state of the profession of instructional technology) are not included in Figure 4.

	Quantitative	Qualitative	Critical Theory	Literature Review	Mixed-methods
Theoretical				31	
Empirical	39	3		1	5
Interpretivist		1			
Postmodern					
Developmental		1		4	1
Evaluation		2		2	5

Figure 4. Classification of ETR&D articles (1989-94).

Figure 5 is an analysis of the research articles published in JCBI (1988-1993). There were one hundred and twenty-nine articles published in JCBI from 1988 through 1993. Five "methodological articles" and one "professional article" are not included in Figure 5.

	Quantitative	Qualitative	Critical Theory	Literature Review	Mixed-methods
Theoretical				17	
Empirical	56			1	4
Interpretivist		2			1
Postmodern					
Developmental				3	2
Evaluation	7	4		3	23

Figure 5. Classification of JCBI articles (1988-93).

There are some obvious trends in the articles that appeared in ETR&D and JCBI during the respective review periods. First, the most common type of article in either publication is empirical in intent and quantitative in method. Thirty-nine articles (38% of the total 104) in ETR&D and fifty-six articles (43% of the total 129) in JCBI fall into the "empirical-quantitative" cell of the matrix.

The next largest subset of articles in these publications can be classified as theoretical in intent and employing literature review as the primary method. I was liberal in my classification of articles into this category. For example, I assigned all of the aforementioned media debate articles into this classification (cf., Clark, 1994a, b; Kozma, 1994a,b). The extent to which literature review methods were actually used in these articles varies greatly.

Another trend that stands out is the paucity of interpretivist articles (one in ETR&D and three in JCBI) during this time. This seems surprising given the numerous applications of the "Constructivist-Hermeneutic-Interpretivist-Qualitative Paradigm" in other fields of education (cf., Eisner, 1991). Although Neuman (1989), Driscoll (1995), Robinson (1995) and others promote interpretivist approaches to research in instructional technology, interpretivist research reports rarely find their way into our publications.

Developmental research studies are also scarce in each of these publications. With respect to ETR&D, it may be that most developmental research studies appear in the development section of the journal, but this is a hypothesis that has not been investigated. Other possible explanations are that instructional technologists rarely conduct developmental research, those that do have too little time to report it, or the review panels for the journals do not recognize this approach as legitimate research.

The complete absence of any articles in these journals that are postmodern in intent or that employ critical theory as a methodology is disappointing, but not too surprising. First, Hlynka and Belland's (1991) volume on the application of postmodern criticism to instructional technology may not be widely known. Second, the gatekeepers of ETR&D and JCBI appear to have strong preferences for empirical research employing quantitative methods. They may be unwilling or unable to entertain such radical departures from standard research methods as have been proposed by Yeaman (1994) and other critical theorists.

An interesting difference between the two journals is the percentage of articles that are evaluative in intent. Only nine (9%) of the articles in ETR&D were evaluation reports during this period whereas thirty-seven (29%) of the articles in JCBI were evaluations. This difference may be explained by evaluation articles in ETR&D being primarily relegated to the development section of the journal. As above, this hypothesis has not been investigated.

The Problem of Pseudoscience

A deeper analysis of those studies published in ETR&D and JCBI which are empirical in intent and quantitative in method yields a dismal picture of the quality of contemporary research in our field. In an earlier article published in the now defunct JCBI (Reeves, 1993), I presented an analysis of five studies published in refereed journals from the literature on learner control (Arnone & Grabowski, 1992; Kinzie & Sullivan, 1989; López & Harper-Meriniak, 1989; McGrath, 1992; Ross, Morrison, & O'Dell, 1989). I characterized the research reported in these articles as pseudoscience. Figure 6 summarizes the characteristics of pseudoscience in the field of instructional technology.

Ironically, the learner control articles analyzed in Reeves (1993) are hardly the worst examples of pseudoscience in our field. My analysis of recent volumes of ETR&D and JCBI indicates that pseudoscience continues to dominate research in the field of instructional technology. A conservative review of the thirty-nine "empirical-quantitative" studies reported in ETR&D indicates that twenty-eight of them (72%) can be identified as examples of pseudoscience in that they possess two or more of the characteristics in Figure 6. In JCBI, thirty-four (61%) of the fifty-six "empirical-quantitative" studies published during this period suffer two or more signs of pseudoscience. This analysis is evidence of a research malaise of epidemic proportions.

Specification error	Vague definitions of the primary independent variables (e.g., learner control versus program control).
Lack of linkage to robust theory	Little more than nominal attention to the underlying learning and instructional theories that are relevant to the investigation.
Inadequate literature review	Cursory literature review focused on the results of closely related studies with little or no consideration of alternative findings.
Inadequate treatment implementation	Infrequent (usually single) treatment implementation often averaging less than 30 minutes.
Measurement flaws	Precise measurement of easy-to-measure variables (e.g., time); insufficient effort to establish the reliability and validity of measures of other variables.
Inconsequential outcome measures	A lack of intentionality in the learning context, usually represented by outcome measures that have little or no relevance for the subjects in the study.
Inadequate sample sizes	Small samples of convenience, e.g., the ubiquitous undergraduate teacher education or psychology majors.
Inappropriate statistical analysis	Use of obscure statistical procedures in an effort to tease statistically significant findings out of the data.
Meaningless discussion of results	Rambling, often incoherent, rationales for failing to find statistically significant findings.

Figure 6. Characteristics of pseudoscience (Reeves, 1993).

The question inevitably arises with respect to how so many pseudoscience studies get published. At least part of the answer rests in the incestuous nature of the relationships among the people conducting these studies and the people charged with peer review of these submissions. The review boards of these journals include many of the same people whose research studies exemplify pseudoscience. Not only does the insular nature of the review process assure these researchers of a venue for their pseudoscience reports, but it also at least partially explains the under representation of alternative approaches of inquiry.

To understand the steady flow of pseudoscience in instructional technology, it is necessary to look at its source. Most of it emanates from colleges and schools of education that have graduate programs in instructional technology. As Kramer (1991) points out in *Ed School Follies*, these institutions are "intent on proving that education is an academic discipline with its own subject matter worthy of a place alongside other university schools and departments (p. 8). The faculty in these programs are subject to the same "publish or perish" pressure as their colleagues in arts and sciences. They quickly learn that it is the number of refereed publications they can amass, not the relevance or value of their research, that really matters when they come up for tenure and promotion.

Needless to say, this problem is hardly limited to instructional technology programs. Colleges and schools of education reward pseudoscience in every discipline from early childhood education though vocational education. A new report issued by the Holmes Group called "Tomorrow's Schools of Education," calls for tenure and promotion guidelines to be revamped so that professors are rewarded less for research and publication and more for work in the public schools (Nicklin, 1995). If such a radical shift in the reward structure could be accomplished, I cannot believe that we would continue to conduct pseudoscience when we could be rewarded for making a difference in the schools where the needs are so great.

Frankly, the likelihood of changing the reward structure within universities seems at best remote. However, as instructional technologists, we do not have to wait for such a change to occur. Another way of increasing the relevance of instructional technology would be to call a moratorium on our efforts to find out how instructional technology can effect learning through empirical research. Instead, we should turn our attention to making education work better. It seems obvious to me that we stand a better chance of having a positive influence on educational practice if we engage in developmental research situated in schools with real problems.

Can reports of developmental research be published? Of course! After all, as noted above, the same people who conduct the research are the gatekeepers who determine what is accepted for publication in our most important journals. As academics, we are all in this together, and if we want to fundamentally change the nature of our "game," we can. In this manner, we can still meet the frustrating, but practical, requirements of the larger academic game by providing our instructional technology scholars with an outlet in refereed publications, albeit ones that have been radically improved in terms of goals, methods, and relevancy.

Steps Toward Socially Responsible Research

The relevance of pseudoscience research studies is a moot point. Even if the researchers themselves ascribe to the highest ideals of scientific inquiry, research so flawed has little relevance for anyone other than the people who conduct and publish it. But it is not enough to criticize research in instructional technology as characterized by pseudoscience and social irrelevance. Alternatives to the old ways must be found. Some may demur, believing that instructional technologists are incapable of conducting valid, socially relevant research, and that they should stick to instructional design and evaluation, leaving educational research to cognitive psychologists or practitioners better equipped to conduct it. I disagree. I think we can and will conduct meaningful research provided we acknowledge the sterility of our existing research base and build anew from a foundation of sound learning theory and rededicated concern for the social impact of our research.

What would be the nature of a new socially relevant research agenda? Two recent studies that represent a change in direction toward developmental research are the dissertation study conducted by Idit Harel at M.I.T. (1991) and the on-going research of Richard Lehrer (1993) and his associates at the University of Wisconsin.

Harel's (1991) Instructional Software Design Project (ISDP) represents a unique effort to use programming as a cognitive tool within a software design context. Harel's ISDP combines Papert's "constructionist" theory (1993) with Perkins "knowledge as design" pedagogy (1986). In her dissertation research, seventeen fourth grade students used Logo for a semester to create software products that were intended to teach fractions to third grade students. Her study combined quantitative, qualitative, and comparative research methods to investigate the effects of this "learners as designers" approach.

Harel reports that the fourth grade students spent an average of seventy hours working on their software design projects. The actual nature of the software the students designed was open, but they were two requirements for students in the program: 1) writing in a "Designer's Notebook" every day, and 2) attending periodic "Focus Sessions" about software design, Logo programming, and fractions. A teacher and the researcher were available at all times to help the students with their design efforts. Although each of the students produced a separate software product, collaboration among the students was encouraged.

Harel compared the differences in Logo skills and fractions knowledge between the seventeen students in the ISDP and thirty-four other students in two classes who were studying Logo and fractions via "a traditional teaching method" (p. 263). No significant differences were found in pretests among the three classes. Harel reports that "In general, the 17 children of the experimental class did better than the other 34 children on all posttests (Fractions and Logo)" (p. 272). Although not all differences were statistically significant, the general trend was quite positive in terms of specific learning outcomes as measured by multiple measures including paper-and-pencil tests, computer exercises, video-taped observations, and interviews.

The major part of Harel's (1991) study is a detailed description of the activities and metacognition of one student, "Debbie," over the four month period of the project. Harel wrote that her detailed analysis of Debbie's work as well as her observations of other students indicated that "Throughout ISDP, the students were constantly involved in metacognitive acts: learning by explaining, creating, and discussing knowledge representations, finding design strategies, and reflecting on all of the above" (p. 359). In addition to positive cognitive effects in terms of metacognition, Harel concluded that the ISDP students acquired enhanced cognitive flexibility, better control over their problem-solving, and greater confidence in their thinking abilities. She notes however that the study did not include any direct measures of thinking skills, but is grounded in her own interpretations of the students' metacognition and problem-solving processes based upon observations and analysis of documentation such as their Designer's Notebooks.

Lehrer (1993) describes the development, use, and results of a hypermedia construction tool called *HyperAuthor* that eighth graders used to design their own lessons about the American Civil War. This approach is based upon the cognitive learning theory that knowledge is a process of design and not something to be transmitted from teacher to student (Perkins, 1986). Lehrer's students were engaged in "hyper-composition" by designing their own hypermedia. In this mode, learners transform information into dimensional representations, determine what is important and what is not, segment information into nodes, link the information segments by semantic relationships, and decide how to represent ideas. This is a highly motivating process because authorship results in ownership of the ideas in the hypermedia (Jonassen, in press).

Lehrer's subjects were high and low ability eighth graders who worked at the hypermedia construction tasks for one class period of 45 minutes each day over a period of several months. The students worked in the school's media center where they had access to a color Macintosh computer, scanner, sound digitizer, *HyperAuthor* software, and print and non-print resources about the Civil War. An instructor was available to coach students in the conceptualization, design, and production of hypermedia. Students created programs reflecting their unique interests and individual differences. For example, they created hypermedia about the role of women in the Civil War, the perspectives of slaves toward the war, and "not-so-famous people" from that period.

According to Lehrer, "The most striking finding was the degree of student involvement and engagement" (p. 209). Both high and low ability students became very task-oriented, increasingly so as they gained more autonomy and confidence with the cognitive tools. At the end of the study, students in the hypermedia group and a control group of students who had studied the Civil War via traditional classroom methods during the same period of time were given an identical teacher-constructed test of knowledge. No significant test differences were found. Lehrer conjectured that "these measures were not valid indicators of the extent of learning in the hypermedia design groups, perhaps because much of what students developed in the design context was not anticipated by the classroom teacher" (p. 218).

However, a year later, when students in the design and control groups were interviewed by an independent interviewer unconnected with the previous year's work, important differences were found. Students in the control group could recall almost nothing about the historical content, whereas students in the design group displayed elaborate concepts and ideas that they had extended to other areas of history. Most importantly, although students in the control group defined history as the record of the facts of the past, students in the design class defined history as a process of interpreting the past from different perspectives. In short, the hypermedia "design approach lead to knowledge that was richer, better connected, and more applicable to subsequent learning and events" (p. 221).

A New Beginning

What a contrast exists between the Harel (1991) and Lehrer (1993) studies and the morass of pseudoscience endemic in our field! In the first instances, pedagogical models grounded in robust learning theories have been identified, and subsequently, powerful technologies have been used to implement these models. In the latter, the power of various forms of technology to instruct is assumed, and reductionist experiments are conducted to detect its effects. In Harel's study, children with authentic needs experienced a powerful learning opportunity over a period of months. In most pseudoscience studies, undergraduates earn "extra credit" for less than an hour of their time spent using some form of mediated "treatment" that has little or no relevance for them.

In a landmark paper about educational research, Salomon (1991) describes the contrast between analytic and systemic approaches to research. Salomon claims that this contrast transcends the "basic versus applied" or "quantitative versus qualitative" arguments that so often dominate debates about the relevancy of educational research. Salomon concludes that the analytic and systemic approaches are complementary, arguing that "the analytic approach capitalizes on precision while the systemic approach capitalizes on authenticity" (p. 16).

While I agree with Salomon in theory, the dominance of pseudoscience in I.T. invalidates this complementarity in practice. The ugly truth is that many of us who engage in analytic research approaches consistently violate many of the basic premises of this paradigm, especially with respect to the testing of meaningful hypotheses derived from strong theory (Reeves, 1993). Although we may eventually be able to conduct valid, socially responsible analytic studies in this field, that time has not yet arrived. We need a valid body of systemic (interpretivist, postmodern, and developmental) research before we begin to have theoretical foundations strong enough to pursue an analytical agenda.

Is instructional technology research socially responsible? At the present time, it is not. Are we asking the wrong questions? For the most part, yes. Can we change this sad state of affairs? Of course, if we have the will! Salomon (1991) points the way. A major benefit of systemic research in education is that it yields new questions and nurtures the development of new theory. The aforementioned moratorium on analytic studies in our field could give us the theoretical foundations for a socially relevant analytic research agenda early in the 21st Century. There are hopeful signs as indicated by the studies of Harel (1991) and Lehrer (1993) and the methodological prescriptions of Neuman (1989), Newman (1990), and Salomon (1991).

I believe that the research malaise in I.T. stems in part from the "mindlessness" that is endemic in so much of our professional and personal lives as we near the 21st Century. Although some would attempt to redirect or revive the pseudoscience approach to I.T. research (cf., Ross & Morrison, 1989), it is clear that much of our research continues to suffer from the same mindless misconceptions and irrelevance identified by previous critics (Lumsdaine, 1963; Mielke, 1968; Schramm, 1977; Clark, 1983; Salomon, 1991). The social psychologist, Ellen Langer, documents the terrible costs of mindless behavior in education, health care, and business in her book 1989 book, ***Mindfulness***. She writes:

> When we are behaving mindlessly, that is to say, relying on categories drawn in the past, endpoints to development seem fixed. We are then like projectiles moving along a predetermined course. When we are mindful, we see all sorts of choices and generate new endpoints. Mindful involvement in each episode of development makes us freer to map our own course. (pp. 96-97)

The demise of JCBI, the recurring "influence of media" debate, and the prevalence of pseudoscience in our field are all signals that we need to become more mindful about our research. If we continue as before, mindlessly conducting pseudoscience, the obsolescence of our field per se is a likely outcome. Already, the most exciting learning and performance environments are not coming out of Departments of Instructional Technology (cf., Cognition and Technology Group at Vanderbilt, 1992; Gery, 1995). On the other hand, as Langer emphasizes, mindfulness opens up all kinds of possibilities. Let us seize this opportunity to stop being pawns in "someone else's costly construction of reality" (p. 28) and realize that we, and we alone, can assure the validity and social relevance of research in instructional technology.

Background of Author

THOMAS C. REEVES, Ph.D., is a professor of instructional technology at The University of Georgia where he teaches evaluation and multimedia design. Since receiving his Ph.D. at Syracuse University in 1979, he has developed and evaluated numerous interactive multimedia programs for education and training. He has been an invited speaker in Australia, Brazil, Bulgaria, Finland, Peru, Russia, South Africa, Switzerland, Taiwan, and the USA. His research interests include: 1) evaluation, 2) mental models, 3) electronic performance support systems, and 4) instructional technology in developing countries.

Notes

1. The belief that biologists and other natural scientists don't have to be as concerned about the social relevance of their research as social scientists is being tested in the courts (Leatherman, 1995). A female biology professor denied tenure at Vassar College sued on the grounds that the research of the male professors who voted on her tenure decision was less important than hers. The judge agreed finding that her research on skin differentiation might have "important implications" for cancer research whereas the research of the one of her male colleagues on spider behavior was "narrow" and subject to ridicule (p. A14).

2. Although I would have preferred to examine research publications in both journals during an identical six year period, this was not possible. ETR&D began its new format in 1989, and JCBI ceased publication at the end of 1993.

3. I am grateful to Marcy Driscoll, Don Ely, Kent Gustafson, Mike Hannafin, John Hedberg, and Walter Dick for their generous guidance in the development of this revised classification scheme. Of course, I take full responsibility for the flaws that will no doubt be revealed in its organization.

4. ETR&D is a product of the integration of two journals previously published by the Association for Educational Communications and Technology (*Educational Communications and Technology Journal* and

Journal of Instructional Development). ETR&D is divided into two sections, a research section and a development section. This analysis only considered the research section of ETR&D.

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Title:

An Experiment on Effects of Redundant Audio in Computer Based Instruction on Achievement, Attitude, and Learning Time in 10th Grade Math

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Abstract

In the tradition of dual versus single channel research, this field experiment investigated the effects of the inclusion of matched redundant digital audio on achievement in, time spent in learning and attitude towards CBI delivered mathematics at the high school level. Differential effects on students of varying entry learning math performance was also investigated. Mathematics 10 subjects (N=82) were assigned to the two main treatment conditions (CBI_audio, CBI_text) by stratified match pairs within three existing classes. Both treatment groups completed the same three lessons of one unit of Math*Tech 10*. Math*Tech 10* is a course in the Alberta curriculum which is delivered by CBI, contains 110 lessons and incorporates 16 self-diagnostic exams. The three selected lesson files for the treatment condition were modified by adding redundant audio (male voice instructions), except for the exams and those portions of the lesson where random generation were used. Analysis of scores of a math achievement test measuring the objectives of the lessons revealed that assignment to the two CBI delivery modes did not have a significant effect on the overall comprehension and learning mastery of the related mathematical materials. No significant differences between the lower ability students across the two treatment groups were observed. Several different time measures were addressed in the study. Overall study times were equivalent for main treatment groups but higher ability dual channel students took more time overall than their control group counterparts. Regarding time to complete the practice questions built into each lesson, the higher ability dual channel students took less time to complete the questions with equivalent achievement scores, implying greater learning efficiency. Overall there were no significant attitude differences between the two main treatment groups. In the dual channel audio treatment condition, lower ability students were generally more positive about learning than the higher ability students. Additional attitude differences were found. The results suggest that redundant audio, added to Computer Based Instruction to teach high school mathematics, has little effect on achievement but does affect learning time, and attitude formation of students of differing learning ability.

The emergence of more powerful computer hardware and software development tools make it technically feasible to incorporate digital audio speech into interactive Computer Based Instruction (CBI). While technically feasible, little actual research has been undertaken with respect to investigating the educational effects of incorporating digital audio speech on the learning process.

Digital audio speech research has narrowly focused on the mechanics of incorporating digital audio speech into existing text-based applications, the "how to" of digital voice integration. Contemporary research assumes the relative educational effectiveness and desirability of the inclusion of digital audio speech in text-based applications. From a hardware and software perspective, it focuses on discovering the best techniques of incorporating digital audio speech into text-based applications. Areas that have received the most attention for the inclusion of digital audio speech are second language training, distance education, adult literacy, special education, early childhood education and reading programs.

Little research to date has investigated the relative benefits and educational effectiveness of the inclusion of digital audio speech in CBI applications, the "why" of audio integration. Furthermore, very little information is available regarding the educational effect, benefits and desirability of the inclusion of digital audio speech in CBI in core subject areas in mainstream educational programs, especially at the junior and senior high school levels. Specifically, the research has not addressed whether the inclusion/exclusion of digital audio speech constitutes a significant user variable in the enhancement of student achievement and attitudes towards CBI Mathematics learning at the senior high school level.

Research on Single and Dual Channel Learning in the Context of CBI

Although substantial research has been conducted on the effects of speech and audio, the results as yet do not provide clear direction. This section summarizes some of the key findings and conclusions.

One of the three stages of our short term memory seems devoted to image retention (iconic memory for visuals, echoic memory for auditory and haptic for touch and senses) (Dempster, 1985). People can discriminate among 4 sounds at a time but the short term echoic storage lasts only 2 seconds before accuracy of recall begins to decline (Darwin, Turvey & Crowder, 1972).

Studies have examined learning from single and dual channel sources. McLuhan observed in 1969 that when information is simultaneous from all directions at once, the culture is auditory and tribal, regardless of its pas or its concepts.

Hartman (1961) identified 4 kinds of multichannel information: redundant (e.g., identical audio and text; related (pictorial representation and verbal description); unrelated as in a picture accompanied by a different spoken word; and contradictory (simultaneous presentation of a picture of a man and the spoken word 'women'). Baecker & Buxton (1987) identified several uses for sound; communicating, seizing attention, enhancing visual stimuli, and relieving overload on the learner's information processing and constructivist learning system. As a practical example in video, Hanson (1989) recommended using redundant audio and video if information is to be learned, otherwise use non–redundant audio to direct attention to the video channel.

Hartman (1961) reviewed nine studies comparing simultaneous audio–print presentations with audio alone or print alone and found seven of those supported simultaneous presentation with the remaining being equal. Hsia (1968) concluded that communication efficiency and dependability were higher when audio and visual channels were present compared with audio and visual alone.

Hsia (1969) argued that simultaneous audio visual presentation of identical or highly redundant information should increase the performance of low intelligence learners to that of high intelligence learners. Kozma (1991) suggested that students who are more knowledgeable about the subject can proceed faster and vice versa; these suggest research on interactions between aptitudes of learners and multichannel treatments.

Channel research involving audio is far from conclusive. Barron (1991) for example, found no difference between students who learned via CBI with and without audio. In terms of learning time, Laddaga, Levine and Suppes (1981) found students took the same amount of time in CBI audio as CBI non–audio but perceived the audio as taking longer. When students were allowed to choose audio vs non– audio CBI instruction, about half chose audio.

The Research Study

The purpose of this study was to determine the effects of CBI and redundant audio, as measured by achievement, attitude and time spent in learning 10th grade math concepts. In addition to comparing CBI_audio and CBI_text, differential effects on students of varying entry learning math performance was investigated. It was expected that the treatments would effect students of different learning histories differently.

Materials and Procedures

Math*Tech 10* is a course in the Alberta curriculum which is delivered by CBI, contains 110 lessons and 16 exams, and is suitable for distance delivery and individualized instruction.

Three lessons on Equalities and Inequalities developed in Authorware Professional 1.6 were selected and utilized in their original screen design, instructional content and feedback. CBI_audio was modified by adding redundant audio, except for the exams and those portions of the lesson where random generation was used. Each lesson includes instruction and a practice section.

The male voice audio of on screen text instructions and student performance feedback was digitized using a MacRecorder. After extensive pretesting of various combinations of sampling and compression rates in conjunction with the specific hardware/software parameters of the MacIntosh Classic and Authorware Professional environment, the 11 Khz sampling rate was selected. This sampling rate offered the best available quality voice recording given the test–site parameters – 4 MB RAM, 20 MB MacIntosh Classic Hard Drive, 512 K cache. As noted by Barron (1991), the 11 Khz sampling rate exceeds acceptable industry standards for voice recording at the time of the study. Due to the CBI_audio lessons' large size and demand on processing speed, all lessons (CBI_audio and CBI_text) were run on 30 stand– alone MacIntosh Classic learning stations rather than delivered through the school's MacJanet network. Program modifications resulted in differential file sizes (CBI_audio = 17 MB, CBI_text = 1.2MB). Audio compression was not used in this study due to technological limitations. Data were collected in the Fall of 1993 from a large suburban high school

The lessons took 335 minutes to complete over 5 days. Students (N = 82) from the three classes (2 teachers) in a single high school were randomly assigned in stratified matched pairs to treatment (CBI_audio) or control (CBI_text).

The field experiment used a two–factorial design (ability X treatment) across three dependent variables (achievement in, time spent in learning and expressed attitude towards CBI mathematics). The two levels of entry level math abilities were measured by scores in the previous year of mathematics (higher ability students mean Grade 9 final mark = 86.30, lower ability students mean Grade 9 final mark = 61.14).

Data Sources

The dependent variable of achievement was measured by a series of content examinations and a 25 item Unit exam targeted to the objectives of the three lessons. Time spent in learning was assessed using the built–in clock function of the computer and included completion of instruction module, completion of practice questions and total connect time. Attitude was assessed through a 42 item Likert– type instrument designed to identify attitude towards learning mathematics by computer.

Results– Achievement

Analysis of scores of a math achievement test measuring the objectives of the lessons revealed no difference between the two treatment groups (Table 1) and no difference between lower ability students across the two treatment groups (Table 2).

Table 1
t-test for Paired Samples on Final Exam Scores

No of Pairs: 41 df: 40 t-value(0.95): -.06

Group:	Mean:	SD:	SE:
CBI_audio	64.83	18.17	2.84
CBI_text	65.00	17.50	2.73

Table 2
ANOVA - Lower Ability Students Final Exam Scores

Source	df	Sum SQ	Mean SQ	F	P
Between:	1	107.3	107.3	.45	.51
Within:	40	9547.0	238.7		
Total:	41	9654.3			

Group:	Mean:	SD:	SE:	Range
CBI_audio	52.58	17.07	3.73	24.5-84.3
CBI_text	55.78	13.64	2.98	32.4-80.6

Results–Time

Several different time measures were addressed in the study. Overall study times were equivalent for CBI_audio and CBI_text (Table 3) but the higher ability audio students took more time (22.3%) overall (Table 4). Regarding time to complete the practice questions built into each lesson, the CBI_audio students took less time (25.9%) than the CBI_text group (with equivalent achievement scores), implying greater learning efficiency for CBI_audio condition than for CBI_text (Table 5).

Table 3
t-test for Paired Samples
on Time Spent in Learning (Seconds)

No of Pairs: 41 df: 40 t-value(1.67): 1.41

Group:	Mean:	SD:	SE:
CBI_audio	4421.7	1370.2	214
CBI_text	4064.8	1460.2	228

Table 4
ANOVA -Higher Ability Students
on Time Spent in Learning (Seconds)

Source	df	Sum SQ	Mean SQ	F	P
Between:	1	5.69	5.69	4.32	.045
Within:	38	50.00	1.32		
Total:	39	55.72			

Group:	Mean:	SD:	SE:
CBI_audio	4126	1302	291
CBI_text	3372	969	217

Note: SumSq & Mean SQ X 1,000,000

Table 5
ANOVA-Practice Exercise Time (Sec)

Source	df	Sum SQ	Mean SQ	F	P
Between:	1	6.16	6.16	6.05	.02
Within:	80	81.39	10.17		
Total:	81	87.55			

Group:	Mean:	SD:	SE:
CBI_audio	2115	777	121
CBI_text	2664	1196	187

Note: SumSq & Mean SQ X 1,000,000

Results-Attitude

In the CBI_audio condition, lower ability students were more positive about learning (13%) than the higher ability students (Table 6). Overall there were no attitude differences between the two treatment groups (Table 7). Additional attitude differences were found.

Table 6
ANOVA - Lower / Higher Ability Students Within CBI_audio

Source	df	Sum SQ	Mean SQ	F	P
Between:	1	542.3	542.3	5.15	.03
Within:	39	4105.5	105.3		
Total:	40	4647.8			

Group:	Mean:	SD:	SE:	Range
CBI_audio	54.65	10.35	2.31	35.4-74.9
CBI_text	61.93	10.18	2.22	36.7-81.4

Table 7
t-test for Paired Samples
on Expressed Attitude Scores

No of Pairs: 41 df: 40 t-value(0.75): .32

Group:	Mean:	SD:	SE:
CBI_audio	58.38	10.78	1.68
CBI_text	57.71	8.79	1.37

Educational Importance of the Study

The results suggest that redundant audio, added to CBI to teach high school mathematics, has little effect on achievement but does affect learning time and attitude formation of students of different learning ability. In light of the energy and effort required to incorporate audio into general instruction, the file space required (given current levels of file compression) and current speeds of processing and delivery of instruction to students, one can legitimately question the payoff in terms of achievement, attitude, or learning time. The value of audio in terms of securing a publisher for courseware should be investigated as a separate issue. Further hypothesis and implications are discussed in the full presentation.

Suggestions for further research include an examination of the cost-effectiveness with respect to developing and delivering audio relative to achievement, instructional time and attitude. The sex of the voicing was controlled--one could investigate effects of different voicings, such as peer or authoritative voice crossed with gender. Finally, the use of non-redundant audio should be investigated.

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Title:

The Relationships Among Measures of Intrinsic Motivation, Instructional Design, and Learning in Computer-Based Instruction

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Why would a person want to learn? This is one of the central questions of education. Many arguments have been generated as to why learning benefits both the individual and their society. But these rationales focus on the outcomes of learning, not the process itself. For instructional designers, whose task it is to create learning environments, the key question is "what variables encourage learning for its own sake?"

The study of motivation has long been a neglected area in instructional technology. The emphasis on promoting effectiveness and efficiency in instructional design often excludes concerns about the appeal of instruction. Traditionally handicapped by the lack of theory and lack of measurements dealing with motivation, instructional designers have assumed that good quality instruction will in itself be motivating (Keller, 1983). However, motivation is such a crucial issue in education that simple assumptions are not sufficient.

Our culture tends to emphasize extrinsic motivation, that is, the use of externally supplied rewards and punishments as a means of controlling behavior. However, the use of an extrinsic reward has a hidden cost in that it has a negative effect on an individual's *intrinsic* motivation, that is, motivational states which are internally supplied or generated (Deci & Ryan, 1985). With an intrinsic motivational strategy, the reward arises out of direct involvement with an ongoing activity, which in turn, increases the participant's ability to grow in terms of personal complexity (Csikszentmihalyi, 1978).

The intent of this study was to explore the intrinsic aspects of motivation, and to see if the design of instruction could positively affect learners' levels of intrinsic motivation toward the subject matter.

Statement of the Problem

This research concerned the relationship between intrinsic motivation, differing instructional designs, and learning in computer-based instruction. Specifically, it addressed the following questions:

1. Will different computer-based instructional treatments which have been designed to reflect principles of intrinsic motivation to varying degrees produce measurably different levels of intrinsic motivation in learners?
2. Can the data from this study be explained in terms of the flow model?
3. Are higher levels of intrinsic motivation associated with higher learning scores?
4. Are prior learning and prior interest related to different levels of intrinsic motivation?

Theoretical Framework

The primary theoretical framework for this study is the work of Mihaly Csikszentmihalyi (1975, 1990, 1993; Csikszentmihalyi & Csikszentmihalyi, 1988), which is generally described as "flow theory." Csikszentmihalyi's work deals with identifying and defining the structural characteristics of "optimal" experiences, that is, experiences which are perceived to be challenging, exhilarating, absorbing, and fun.

The flow phenomenon is best described in terms of its two parameters, challenge and skills. When these two factors are in balance, people feel that they have the skills necessary to achieve a challenging, but realistic, goal (Csikszentmihalyi, 1982). A challenge is perceived as an activity that has clear goals and requires an investment of effort in order for the goal to be achieved. Skills are those efforts that an individual needs to apply towards the achievement of the goal. Implicit in this model is the characteristic of feedback, which allows an individual to track his or her efforts in achieving the goal.

Csikszentmihalyi (1993) states that flow-like activities have four main characteristics:

> (1) they have concrete goals and manageable rules, (2) they make it possible to adjust opportunities for action to our capabilities, (3) they provide clear information about how well we are doing, and (4) they screen out distractions and make concentration possible (p. xiv).

Flow experiences are informative in nature, that is, they are clearly bounded by rules and goals, yet are flexible enough to allow an individual to exert effort and see the results of those efforts.

The emotional effects of attempting to achieve any goal can be classified according to the ratio of challenge to skill an individual applies to the task. These ratios are termed "channels" and are grouped into classes and defined by Csikszentmihalyi as: flow, in which the level of challenge is equal or slightly above the level of skill required to achieve the task; anxiety, in which the level of challenge is greater than the amount of skill necessary for the task; apathy, in which both the level of challenge and the level of skill is low; and boredom, in which the level of challenge is lower than the amount of skill an individual can bring to the task (Csikszentmihalyi & Csikszentmihalyi, 1988).

Flow is perceived as a positive experience because the mastery of an achievable challenge stretches an individual's capabilities by promoting the development of new skills and increasing self-esteem and personal complexity (Csikszentmihalyi & LeFevre, 1989). In addition, remaining in the state of flow requires further increases in the complexity of the challenge, thereby promoting growth.

While in a state of flow, people often report feeling more active, alert, concentrated, happy, satisfied, and creative (Csikszentmihalyi & LeFevre, 1989). Flow produces a sense of focused concentration described as the "merging of activity and awareness" which Csikszentmihalyi claims "produces harmony within the self" (Csikszentmihalyi & Csikszentmihalyi, 1988).

The traditional approach to studying flow is through the use of the Experience Sampling Methodology. The ESM randomly samples the day-to-day activities of subjects over a period of time, usually one week. These experiences are captured in a series of open-ended questions relating to what the person was doing and Likert-scale items which relate to the individual's motivational state which can then be classified and quantitatively analyzed. This methodology has been used with a wide variety of populations, ranging from adolescents to the elderly, and in a number of cross-cultural settings (Sato,1988; Allison & Duncan, 1988; Han, 1988; Carli, Della Fave, & Massimini, 1988). These studies confirm flow theory's major hypothesis: that which makes an experience enjoyable and motivating is the balance between the challenge of the activity and the skills of the individual.

Although flow activities can take many forms, and to a certain degree depend upon individual interests and tastes, the theory shows that manipulating the structural variables of challenge, skill, and feedback can increase the likelihood that an individual will find an activity to be motivating. Within the field of computer software, video games are a classic example of how structural factors in the design of the program can affect the intensity of use. Malone's research (1981a, 1981b) indicates that the two factors that most clearly distinguish popular video games are the ability of the game to provide a clear goal and to provide feedback in the form of a score. From the perspective of flow theory, the goals of these games are interpreted as an achievable challenge while the scoring mechanism provides immediate information to the user as to their skill level.

Materials for the Study

The instructional materials for this study consists of three computer-assisted instructional programs on the topic of the relationship of aperture and shutter speed to exposure, depth-of-field, and image blur. These materials were designed according to a set of prescriptions based upon the challenge, skills, and feedback structure of flow theory, with additional specific recommendations derived from the work of Keller (1983, 1987) and Vallerand, Deci & Ryan (1987) (as cited in Rezabek, 1994).

Treatment #1 utilized a linear design in which subjects were exposed to a fixed sequence of topics. This treatment contained embedded questions with feedback, illustrations and animation in support of the instructional material. It was hypothesized that this treatment would be the least motivating of the three due to its inability to vary the challenge level. Treatment #2 contained the same content material but was organized into a "hypermedia" style structure which gave the subjects a choice over the sequencing of the instruction. It was hypothesized that this treatment would be somewhat more motivating due to the increased use of learner control over the material. Treatment #3 utilized a series of camera simulators with embedded instructional sequences for both presentation of the material and opportunities for practice. This treatment provided feedback in the form of photographs whose characteristics varied according to the settings of the simulators. In addition, Treatment #3 utilized a "Jeopardy™" style game at the end of instruction in lieu of embedded questions. This treatment was designed to be the most motivating of the three, incorporating a varying challenge level, a high degree of learner control, and instantaneous feedback which was natural to the task.

A conventional multiple choice test was developed to act as both a pre-test and a post-test. A prior interest survey form was developed for the purpose of gathering sufficient data to control for the impact of prior-interest on intrinsic motivation. A number of Likert-scale type questions were utilized that emphasized interest, rather than competence, in the subject matter.

Measures of intrinsic motivation were gathered through the use of the Experience Sampling Form (ESF) and the Intrinsic Motivation Inventory (IMI). The Experience Sampling Form modified for use in this study was closely modeled after the example provided in Csikszentmihalyi & Larson (1987). The specific data pertaining to the clusters of dependent variables in this study (affect, activation, cognitive efficiency, and motivation) were provided by utilizing a number of Likert scales measuring these dimensions of the respondents experience.

A second measure of intrinsic motivation was provided through the use of the Intrinsic Motivation Inventory, a series of 18 Likert scale items designed to elicit subjects' responses along four underlying dimensions of interest-enjoyment, perceived competence, effort, and pressure-tension. The IMI used in this study was closely modeled after the example provided in McAuley, Duncan & Tammen (1989). This second scale was used to provide additional data to support the reliability and validity of the measures of intrinsic motivation used in this study.

Experimental Design

The research design employed as the primary dependent variables the Likert scale questions of ESM and the IMI which were clustered into their appropriate subdimensions. The independent variables consisted of the three computerized instructional treatments, 1, 2, and 3, which were designed to create predicted effects of low, intermediate, or high intrinsic motivation. In addition, the design employed a correlational analysis of the relationship between intrinsic motivation and learning, and explored the effects of prior-learning and prior-interest on levels of intrinsic motivation. Post test scores were used to measure the dependent variable of learning, and pre-test scores along with the prior interest survey was used as measures of prior learning and prior interest.

Procedures

Approximately 120 subjects were randomly assigned to the three treatment groups. Subjects in each treatment group interacted with a computer-based instructional program designed to teach the topic of the relationship of aperture and shutter speed to exposure, depth-of-field, and image blur in the making of a photograph. Each treatment taught the same objectives but varied as to the instructional design utilized, as described previously.

A few days prior to the experiment, the subjects took a pre-test and completed the prior-interest survey form. The pre-test and any necessary follow on interviews were used to screen out any subjects that had a high level of subject knowledge to ensure a normal distribution of prior-knowledge. Prior-interest scores were utilized later as part of the data analysis phase.

Immediately following the delivery of the instruction in the treatments, subjects were asked to fill out the Experience Sampling Form, designed to capture a quantitative measure of their level of intrinsic motivation experienced during the treatment. In addition, they were also asked to fill out the Intrinsic Motivational Inventory to provide additional data for cross checking the validity of the intrinsic motivation measures. Following this, the subjects completed the post-test.

This collection procedure yielded the following types of data: pre-test, post-test, prior-interest, and two separate measures of intrinsic motivation for each subject in each of the treatments.

Results

The first hypothesis studied the effects of differing instructional treatments on subjects' levels of intrinsic motivation. It was expected that treatment #3, which utilized the greatest number of prescriptions, would have the strongest effect on intrinsic motivation.

Data for the three treatments were analyzed by using Dunn's planned comparison procedure in order to find differences between the groups on measures of intrinsic motivation. Only one comparison, between treatments 2 and 3 on the Perceived Competence subdimension of the IMI, was found to be significant (see table 1). The comparison of this subdimension, which measures respondents' sense of competence, skill and confidence toward the activity, showed that the mean scores for the treatment #2 group were greater than the mean scores for treatment #3, counter to the predicted direction. Since the distinguishing characteristics of treatment #2, the non-linear hypermedia structure, was also present in treatment #3, it is possible that the significance of this comparison is a statistical fluke, and would disappear in subsequent replications of the study. For the ESF data, no comparisons were found to be significant. The hypothesized superiority of treatment #3 over the other treatments on the other measures of intrinsic motivation was not supported by the data.

The second part of the study looked at an aggregate of the data to explore the validity of flow theory within an instructional context, and to establish a link between intrinsic motivation and achievement. A multivariate analysis of variance (MANOVA) was used to determine if subjects who fit the "flow" condition (both challenge and skill reported in the upper end of the scale) differed from subjects who reported a "no flow" condition.

TABLE 1:
IMI Planned Comparisons - Differences Among Means

Interest-Enjoyment Subdimension:

Treatment	2	1	3
2 ($\bar{x} = 5.49$)	–	.115	.229
1 ($\bar{x} = 5.38$)		–	.115
3 ($\bar{x} = 5.26$)			–

Perceived Competence Subdimension:

Treatment	1	2	3
1 ($\bar{x} = 5.50$)	–	-.383	.736
2 ($\bar{x} = 5.88$)		–	1.119*
3 ($\bar{x} = 4.77$)			–

Effort-Importance Subdimension:

Treatment	2	1	3
2 ($\bar{x} = 5.38$)	–	-.457	.191
1 ($\bar{x} = 5.84$)		–	.648
3 ($\bar{x} = 5.19$)			–

Tension-Pressure Subdimension:

Treatment	1	2	3
1 ($\bar{x} = 6.11$)	–	-.303	.787
2 ($\bar{x} = 6.41$)		–	1.091
3 ($\bar{x} = 5.32$)			–

* Significant at the 0.05 level

For the Experience Sampling Form, this distinction was found in two of the four subdimensions: Cognitive Efficiency and Motivation (see table 2). For the Intrinsic Motivation Inventory, the distinction between the "flow" and "no flow" conditions was found in the two subdimensions of Interest-Enjoyment and Perceived Competence (see table 3). These results were in the hypothesized direction, that is, the means of the "flow" group were greater than the means of the "no flow" group. In general, there is evidence to support the perceived relationship between flow and measures of intrinsic motivation, as predicted by the theory.

TABLE 2:
MANOVA : ESF subdimensions by Flow - No Flow condition

	Source	df	Type III SS	MS	F
Affective					
	FLOW/NO FLOW	1	0.0002	0.0002	0.00
	Error	99	47.446	0.479	
Activation					
	FLOW/NO FLOW	1	1.101	1.101	2.37
	Error	99	45.946	0.464	
Cognitive Efficiency					
	FLOW/NO FLOW	1	1.722	1.722	8.19 *
	Error	99	20.818	0.210	
Motivation					
	FLOW/NO FLOW	1	3.649	3.649	16.59 *
	Error	99	21.779	0.219	

* $p < .05$

TABLE 3:
MANOVA: IMI subdimensions by Flow - No Flow condition

	Source	df	Type III SS	MS	F
Interest-Enjoyment					
	FLOW/NO FLOW	1	5.240	5.240	4.78 *
	Error	104	39.699	0.992	
Perceived Competence					
	FLOW/NO FLOW	1	13.314	13.314	10.35 *
	Error	104	133.783	1.286	
Effort-Importance					
	FLOW/NO FLOW	1	2.502	2.502	2.38
	Error	104	109.519	1.053	
Tension-Pressure					
	FLOW/NO FLOW	1	3.013	3.013	2.00
	Error	104	202.211	1.944	

* $p < .05$

The results of this analysis generated evidence to support the basic assumption of flow theory, that is, the ratio of a subject's challenge level to their skill level can be used as an indicator of intrinsic motivation. It should be noted that the use of the ESF in this study differs in certain regards from the original instrument designers' intention. The ESF was originally used in time series studies where each subject reported their responses to a wide variety of experiences over a fixed period of time. This use of the instrument was in a controlled setting where a subject reported a single response to the experimental stimuli. This study showed that the ESF instrument can be useful in an instructional setting and is capable of distinguishing between the "flow" and "non-flow" states among subjects.

The hypothesis of a positive relationship between measures of intrinsic motivation and achievement was generally confirmed. The ESF had a small to moderate overall correlation on the various measures with significant correlations in the Cognitive Efficiency and Motivation subdimensions. The IMI data also showed moderate overall correlations on all of the four measures, with significant correlations in the Interest-Enjoyment, Perceived Competence and Effort-Importance subdimensions. This link between intrinsic motivation and achievement has often been assumed in the literature, but until now little empirical evidence has been presented (see tables 4 and 5).

TABLE 4:
Correlation between ESF subdimensions and Post Test:

Subdiminsion	N	Pearson *r*	Pr rho > 0**
Overall:			
Affective	100	0.072	0.47
Activation	97	0.175	0.08
Cognitive Efficiency	91	0.438	0.0001 *
Motivation	98	0.374	0.0001 *

* Significant at the 0.05 level
** one-tailed test

TABLE 5:
Correlation between IMI subdimensions and Post Test:

Subdiminsion	N	Pearson *r*	Pr rho > 0**
Overall:			
Interest-Enjoyment	91	0.381	0.002 *
Perceived Competence	106	0.4470	0.0001 *
Effort-Importance	106	0.259	0.007 *
Tension-Pressure	105	0.112	0.25

* Significant at the 0.05 level
** one-tailed test

The third part of this study was exploratory in nature and was concerned with discovering the influence of prior interest and prior knowledge on intrinsic motivation. A common sense assumption underlying this part of the study is that prior interest is a direct measure of an individual's motivation toward a subject. In addition, since photography is rarely taught as a required topic, it was assumed that any prior knowledge of this subject was voluntary on the part of the individual, and hence an indirect measure of intrinsic motivation.

In order to explore the relationship between prior interest, prior learning, and intrinsic motivation, analysis of variance and multiple regression analysis were used.

An ANOVA procedure was designed to see if subjects who reported a high level of prior interest and/or a high level of prior knowledge would report higher levels of intrinsic motivation. Results showed that high prior interest subjects did report higher scores for the Affective and Cognitive Efficiency subdimensions of the ESF (see table 6), and high prior knowledge also resulted in higher scores for the Perceived Competence subdimension of the IMI.

TABLE 6:
ESF: ANOVAs for Exploratory Data Analysis
(Treatment, Prior Interest and Prior Knowledge)

Source	df	Type I SS	MS	F
Affective Subdimension				
Treatment	2	0.095	0.047	0.12
Prior Interest	1	2.161	2.161	5.24 *
Treatment X Prior Interest	2	0.000	0.000	0.00
Prior Knowledge	1	0.052	0.052	0.13
Treatment X Prior Knowledge	2	0.514	0.257	0.62
Treatment X Prior Interest X Prior Knowledge	3	3.411	1.137	2.76 *
Within (error)	88	36.294	0.412	
TOTAL	99	42.530		
Activation Subdimension				
Treatment	2	0.761	0.381	0.89
Prior Interest	1	0.608	0.608	1.41
Treatment X Prior Interest	2	0.991	0.496	1.15
Prior Knowledge	1	0.119	0.119	0.28
Treatment X Prior Knowledge	2	0.070	0.035	0.08
Treatment X Prior Interest X Prior Knowledge	3	1.314	0.438	1.02
Within (error)	85	36.560	0.430	
TOTAL	96	40.424		
Cognitive Efficiency Subdimension				
Treatment	2	2.173	1.087	5.23 *
Prior Interest	1	1.361	1.361	6.55 *
Treatment X Prior Interest	2	0.141	0.017	0.10
Prior Knowledge	1	0.119	0.071	0.34
Treatment X Prior Knowledge	2	0.070	0.035	0.08
Treatment X Prior Interest X Prior Knowledge	3	0.625	0.208	1.00
Within (error)	75	15.587	0.207	
TOTAL	86	20.432		
Motivation Subdimension				
Treatment	2	0.296	0.148	0.72
Prior Interest	1	0.770	0.770	3.77
Treatment X Prior Interest	2	0.658	0.329	1.61
Prior Knowledge	1	0.012	0.012	0.06
Treatment X Prior Knowledge	2	0.028	0.014	0.54
Treatment X Prior Interest X Prior Knowledge	3	0.328	0.109	0.54
Within (error)	86	17.581	0.204	
TOTAL	97	19.673		

* $p < .05$

In addition, the generative verses supplantive approach to learning strategies (Smith & Ragan, 1993) prescribes that individuals with high prior interest and high prior knowledge would benefit from a more generative strategy, whereas low interest/low prior knowledge individuals would require a more supplantive strategy. Generative strategies are more motivating, whereas supplantive strategies tend to be less challenging and less motivating. In this study, treatment #3 was designed to be more generative while treatment #1 took a more structured, supplantive approach. This ANOVA was able to test the predictions of the generative-supplantive hypothesis by adding a third dimension and testing for a treatment x prior interest x prior knowledge interaction. This interaction was found in the Affective subdimension of the ESF. A post hoc analysis revealed that the direction of the prediction was generally confirmed, with the high prior interest/high prior knowledge group in treatment #3 reporting the highest affective scores. However, the low prior interest/low prior knowledge group also reported its highest mean scores for treatment #3, with treatment #1 having the second highest score.

The results of this interaction produced evidence supporting the generative-supplantive hypothesis while also linking it to a theoretically grounded methodology for studying intrinsic motivation. It is notable that this interaction was found in results which earlier could not find the generalized superiority of one strategy over another.

In the stepwise multiple regression analysis, prior interest acted as a significant predictor in all four subdimensions of the ESF, with prior knowledge acting as a significant predictor in the Activation and Cognitive Efficiency subdimensions. However, the total variance accounted for by a combination of these two factors was never greater than .10 (see table 7). Analysis for the IMI resulted in prior knowledge as a significant predictor in the Perceived Competence and Tension-Pressure subdimensions; however only a maximum of .06 of the variance could be accounted for by this factor (see table 8). Overall, the amount of variance accounted for by the predictor variables was very small.

TABLE 7:
ESF: Multiple Regression for Exploratory Data Analysis
(Prior Interest and Prior Knowledge)

Source	Beta	Stepwise Multiple Correlation (R)	Stepwise R^2	R^2 Increment
Affective				
Prior Interest	0.27	0.27	0.07	
Activation				
Prior Interest	0.21	0.17	0.03	
Prior Knowledge	0.21	0.27	0.07	0.04
Cognitive Efficiency				
Prior Interest	0.27	0.23	0.05	
Prior Knowledge	0.21	0.31	0.10	0.05
Motivation				
Prior Interest	0.24	0.06	0.06	

Note. Table includes only those variables that met the .15 level of significance

TABLE 8:
IMI: Multiple Regression for Exploratory Data Analysis
(Prior Interest and Prior Knowledge)

Source	Beta	Stepwise Multiple Correlation (R)	Stepwise R^2	R^2 Increment
Perceived Competence				
Prior Knowledge	0.25	0.25	0.06	
Tension-Pressure				
Prior Knowledge	0.19	0.19	0.04	

Note. Table includes only those variables that met the .15 level of significance

The lack of variance accounted for by prior interest and prior knowledge was surprising since it was anticipated that these two factors would have a strong predictive effect on intrinsic motivation. These results may be due to measurement error, the prior interest inventory and the pre-test were both researcher designed instruments and have not been extensively validated. However, it is doubtful that poor instrumentation could completely account for the extremely low variance found in the multiple regression. It is likely that other, unknown variables account for much of the variance in the intrinsic motivation scores.

Discussion of Findings

The results of this study suggest that attempting to increase intrinsic motivation through the design of instructional materials is more difficult than the literature would indicate. Investigating the data for the ESF leads to some general conclusions about the difficulties of integrating intrinsic motivational prescriptions into the practice of instructional design.

It was surprising that the Activation subdimension scores, containing questions on alertness, involvement, excitement, etc. did not distinguish between the treatments. It was expected that treatment #3 would have a stronger impact on subjects in this dimension because of its simulation and gaming strategies. However, mean scores for all three treatments on these questions were at or below the midpoint of the scale, indicating that these treatments did not generate a very active sense of engagement in the task. It is possible that the design of treatment #3 may not be challenging enough for this particular group of subjects. Defining the optimal challenge requires a careful analysis of the audience, and probably varies widely from one individual to another, thereby greatly compounding the problem for the designer.

However, the Affect subdimension scores were above the midpoint of the scale, indicating a positive sense of happiness, sociability, and relaxation among the subjects. These questions probably reflect a general orientation more strongly influenced by the subject's self perception or world view than a reaction to a specific activity.

Cognitive Efficiency was another subdimension where theory would have predicted a strong effect for treatment #3. This subdimension contained questions on concentration, expectation and satisfaction. It was expected that the simulation elements of treatment #3, which provided a greater amount of problem solving, would have contributed to greater levels of concentration by the subjects. In addition, the gaming element could have contributed to a greater sense of satisfaction. However, results show that subjects in treatment #3 had the lowest means for any of the comparison groups on this subdimension, although this distinction is not significant. Again, it could be concluded that the gaming and simulation elements of treatment #3 were not challenging or extensive enough to make a difference among the subjects.

The motivation subdimension had mixed results. For questions relating to the subject's sense of control, success and satisfaction in all three treatments, respondents scored above the midpoint of the scale. But for the questions relating to the importance of the activity to themselves or to their overall goals, respondents scored at or below the midpoint. It is possible that, although the subjects found the activity to be satisfying, they did not find it to be very relevant to the larger context of their overall goals.

The only significant comparison was between treatments 2 and 3 on the Perceived Competence Subdimension of the IMI. The comparison of this subdimension, which measures respondents' sense of competence, skill and confidence toward the activity, showed that the mean scores for the treatment #2 group were greater than the mean scores for treatment #3, counter to the predicted direction. Since the distinguishing characteristics of treatment #2, the non-linear hypermedia structure, was also present in treatment #3, it is possible that the significance of this comparison is a statistical fluke, and would disappear in subsequent replications of the study.

This study points out the complex, interactive nature of intrinsic motivation. If it is assumed that variables affecting any type of psychological phenomena can be classified into environmental, social, and intrapersonal factors, then it can be seen that this study controlled for only environmental factors, that is, the design of the treatments. Therefore it can be hypothesized that social factors, such as group interaction, and/or intrapersonal factors, such as cognitive styles, probably have a stronger impact on intrinsic motivation than environmental factors alone. As found in the investigation of the interaction between treatments and the factors of prior interest and prior knowledge, it is likely that these social factors will be seen to operate in interaction with critical environmental factors such as instructional strategies.

Conclusion

This study develops evidence that the design of instruction can have an effect on intrinsic motivation, and that intrinsic motivation has an effect on achievement, and that methodologies derived from flow theory are of practical use in an instructional setting. However, the relationships are not clear, and there appear to be many other variables affecting learners' intrinsic motivation. Further research should be conducted to both refine the motivational appeal of instructional materials and to identify those social and interpersonal factors that impact motivation.

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Title:

The Influence of Dominant Languages on the Effectiveness of Graphic Organizers in Computer-Based Instruction

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Abstract

Students' academic achievement scores have been found to improve with the use of graphic organizers. Researchers suggest this may be due to the way graphic organizers depict concepts and relationships between concepts. Unfortunately, most previous research on graphic organizers has been constrained to English speakers in secondary and higher education. To expand our knowledge on graphic organizers and increased learning, the effectiveness of graphic organizers when used by fourth-grade students engaged in computer-based instruction was examined. Additionally, whether the learners' dominant language (Spanish and English) influenced the effectiveness of graphic organizers was studied. A one-way analysis of variance was used to analyze immediate and delayed gain in academic achievement scores of all students. Statistically and educationally significant differences were found in scores favoring students who used graphic organizers over those who used lists of topics. A two-way analysis of variance identified no significant differences between language groups for the effect of graphic organizers on immediate or delayed tests. Limitations of the study and suggestions for future research are examined.

Background

Introduction

Cognitive psychologists generally agree that there are at least two distinct types of human knowledge -- *declarative* and *procedural* (Anderson, 1983; Jonassen, Beissner, & Yacci, 1993). Declarative knowledge is knowing what something is, but it does not imply knowing how to use that knowledge. Defining the word "computer" and identifying the number 24 on a number line are examples of declarative knowledge. Procedural knowledge is knowing how to do something. Knowing how to manipulate physical entities such as accessing a computer application, or mental manipulations such as subtracting two-digit numbers, are examples of procedural knowledge. Procedural knowledge is dependent on an awareness of an object or idea (declarative knowledge) even though we may not be able to articulate that knowledge (Jonassen et al., 1993).

But how does declarative knowledge evolve to the complex forms required for procedural knowledge? To help explain this transition, some psychologists propose an intermediate knowledge type in which facts and concepts learned as declarative knowledge are interrelated with one another to form complex systems. This interrelationship of information, and the way in which we mentally organize it, has been called *structural knowledge* (Diekhoff, 1983).

Structural knowledge can be thought of as a network of mental connections or relationships between pieces of declarative knowledge. As learners develop these structures, they more easily associate independent ideas. These connections allow learners to draw conclusions and understand relationships among concepts. As students begin to develop these underlying structures and organizations of declarative knowledge, they go beyond "knowing what" to a better understanding of "knowing why." Structural knowledge networks appear to create the interconnectedness of ideas that support the development of procedural knowledge.

A variety of techniques have been developed to elicit, represent, and convey structural knowledge (Jonassen et al., 1993). One method being employed in public education is *graphic organizers*. Graphic organizers are spatial metaphors that indicate relationships among concepts in a node-link-node visual display (Anderson, 1990; Jonassen, 1990; Jonassen et al., 1993). *Nodes* contain key concepts. *Links* depict unspecified relationships between nodes (see Figure 1).

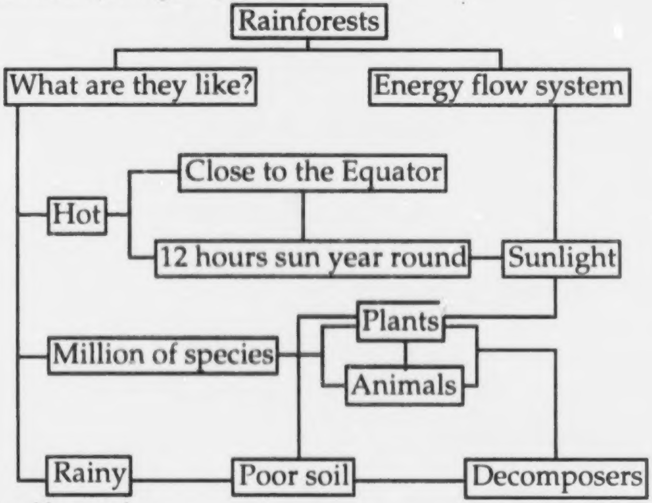


Figure 1. Sample graphic organizer.

Graphic organizers convey relationships and content structures in a pictorial fashion. These visual representations provide learners with a structural overview of information to be learned. This overview directs learner's attention towards key concepts and conceptual relationships rather than seemingly isolated facts. The use of graphic organizers enhances the understanding, organization, and long-term retention of information (Stevensold & Wilson, 1990) and accentuates meaningful learning and information manipulation (Jonassen, 1990; Kerchner, 1990; Peel, 1992). Graphic organizers also facilitate the extrapolation, combination, inference, and other logical reasoning mechanisms that allow learners to transfer and apply information (Jonassen et al., 1993).

Problem Statement

Graphic organizers improve the effectiveness of instruction. However, it cannot be assumed that they affect all students equally. In fact, researchers suggest that the effectiveness of any instructional strategy varies with *individual learner differences* (Dunn, 1990; Oxford 1990; Scarpaci & Fradd, 1985).

Individual learner differences include any personal trait or capability that influence the way students process and use information. Although there are a variety of differences that affect learning, dominant language is a key difference because it serves as a central means for information processing (Sticht, 1992). Dominant language differences do not imply a difference in intelligence, but rather in the way individuals organize and use information (Scarpaci & Fradd, 1985).

Previous research on the effectiveness of graphic organizers generally focused on Anglo-Americans in secondary and higher education. In a review of the literature, no studies were identified that included a bilingual (Spanish -- English) elementary school-aged population engaged in computer-based instruction. This omission limits the generalizability of previous research findings as to the effectiveness of graphic organizers to various populations.

Purpose of Study

The purpose of this study was two-fold: (a) to assess the effectiveness of graphic organizers in computer-based instruction for fourth-grade students, and (b) to determine the relationship between learner's dominant language (Spanish or English) and the effectiveness of graphic organizers in computer-based instruction by comparing mean gain scores across language groups. To accomplish this assessment, the experiment was structured so that gains in academic achievement scores of two groups of fourth-grade students after they engaged in computer-based instruction could be compared. One group accessed an instructional program with embedded graphic organizers; the second group accessed an analogous instructional program, but with embedded lists of topics. The term *embedded* refers to features contained within the programs. Gain score differences between pretest and posttests (immediate and delayed) were used to determine whether the type of embedded feature resulted in a difference in short-term and long-term recall.

Methods

Population and Sample

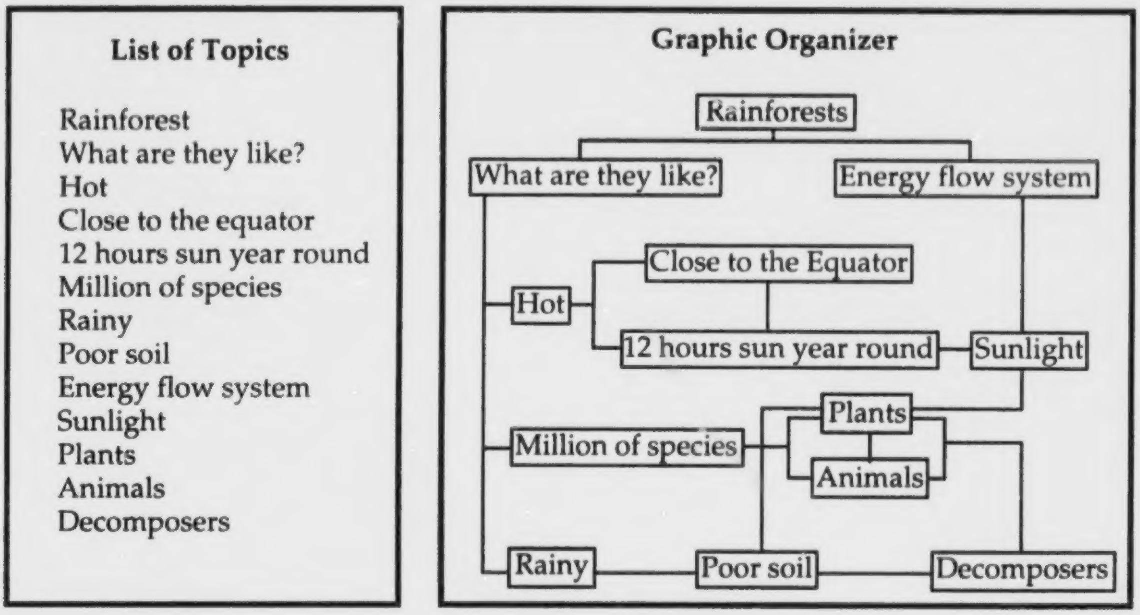
The population under study was fourth-grade students engaged in computer-based instruction. Students enrolled at a single elementary school in a suburb of San Diego, California, served as the accessible population. The sample used in this study was 68 fourth-grade students. Two fourth-grade classes with different teachers were included. The sample included 31 English speaking and 37 Spanish speaking students. English and Spanish speakers were defined by each individual's dominant language of instruction according to school authorities. We dropped three students from the study: Two students did not submit pretests and a third did not submit the delayed posttest. Each subject who completed all components of this study ($n = 65$), participated in a pretest, instructional program, immediate posttest (Posttest 1), and delayed posttest (Posttest 2).

Two important variables led us to choose the location for our study. First, 58% of the school's students are classified as Limited English Proficiency (LEP) or Non-English Language Background (NELB) students. As such, this district represents a microcosm of demographic changes that will soon be facing many California and United States schools in the near future as enrollment of sheltered English students increases. The LEP and NELB subjects in this school are almost all Spanish speakers with Mexican cultural backgrounds. Second, all students between second-grade and fifth-grade spend approximately 20 minutes per day engaged in computer-based instruction. Because of this exposure, and because the study involved computer-based instruction, test results should not be contaminated by the novelty effect that may have influenced results at other research sites.

Materials

Instructional programs. The instructional material included four versions of a computer-based program developed using IBM's "LinkWay™" software. The programs were designed to include content normally presented in the school's fourth-grade science curriculum and structured so that students could complete the instruction in 20 to 30 minutes.

We developed four analogous versions of the instructional program. Two versions were developed in English and two in Spanish. In each language, we developed one program with embedded graphic organizers and one with embedded lists of topics. The difference between the programs was the position of concept labels on the screen and the use of lines connecting these concept labels in the graphic organizers. Otherwise, the programs were identical. Figure 2 shows partial renditions of screens depicting this difference.



List of Topics

Rainforest
What are they like?
Hot
Close to the equator
12 hours sun year round
Million of species
Rainy
Poor soil
Energy flow system
Sunlight
Plants
Animals
Decomposers

Figure 2. Renditions of lists-of-topics and graphic-organizer screens.

The programs consisted of 21 screens containing instructional information, 7 screens representing either lists of topics or graphic organizers, and 3 screens containing user directions and general information regarding the program's presentation.

Screens that presented lists of topics and graphic organizers were designed with three colors. Green identified what material users would see next in each treatment. Pink identified what was just viewed, and white indicated the overall content of material. The colors used in the list-of-topics and graphic-organizer screens served four purposes:

- to provide feedback to the learners on their progress through the program;
- to serve as a preview strategy, highlighting material to be learned (green);
- to serve as a review strategy, highlighting material just learned (pink); and
- to serve as a synthesized overview of all the information in the program (white).

Test Instruments. We developed two versions of the test to match the dominant language (English or Spanish) of the students. The pencil-and-paper academic achievement test consisted of 18 multiple choice questions from the facts, concepts, and rule/principle levels of Gagné's (1977) taxonomy of cognitive skills. Teachers at the treatment school conducted a face-validity measure of the test instrument prior to its use with students. We used the test to gather pretest, immediate posttest, and delayed posttest scores.

Treatment

A stratified sample of dominant English and dominant Spanish speakers were randomly assigned to two treatment groups: Treatment 1 students accessed graphic-organizer screens in the instructional program; Treatment 2 students accessed list-of-topics screens in an otherwise identical version of the program. Within both treatment groups, students accessed instruction developed in their dominant language. Dominant language (English and Spanish) and program type (graphic organizer and list of topics) served as independent variables. Mean gain score differences of achievement tests served as the dependent variables for group results.

The instructional program was limited to a one-shot, 20 minute treatment. All students were provided with a later opportunity to use the non-treatment program to ensure equal educational opportunities to all subjects.

The teachers' role was limited to administering the pretests, immediate posttest, and delayed posttest, and directing students to the computer where they accessed their pre-assigned instructional program.

The administration procedures for this study involved four steps. First, all students took the academic pretest matched to each individual's dominant language. Approximately one day later, students began using the treatment program. Because each classroom had only one available computer, students took turns using the program. After completing the program, students took the immediate posttest to measure their short-term recall. Approximately two weeks after the treatment students took delayed posttest to measure their long-term recall.

Experimental Design

An analysis of variance (ANOVA) statistical procedure was used to identify whether statistically significant differences existed between group mean gain scores. Gain scores were defined as the difference between pretest and immediate posttest scores (Gain 1), and the difference between pretest and delayed posttest scores (Gain 2). Gain scores were used to avoid the impact of individual differences on the level of content knowledge at the start of the study. Dominant language and program type were used as independent variables. Gain 1 and Gain 2 scores served as dependent variables.

We used a one-way ANOVA to determine if statistically significant differences existed between the means of the two treatment groups. To identify if statistically significance differences existed among the four subgroups (two languages by two treatments) a two-way ANOVA was conducted. A predetermined overall level of statistical significance was set at 0.05. The predetermined level of educational significance, as measured by the standardized mean difference effect size (calculated by dividing mean differences of the posttest by the standard deviations of the scores from the untreated groups) was set at 0.25 (Tallmadge, 1977).

Results

Overview of Descriptive Statistics

Table 1 presents mean gain scores, standard deviations, and sample sizes for the four treatment groups involved in this study. Mean gain scores are presented for two instances: Gain 1 (defined as the difference between immediate posttest scores and pretest scores) and Gain 2 (defined as the difference between delayed posttest scores and pretest scores).

Table 1
Means, Standard Deviations, and Sample Sizes for All Groups

		Gain 1		Gain 2		
Treatment	Groups	*M*	*SD*	*M*	*SD*	*n*
List of Topics	English	2.61	1.56	1.01	1.04	13
List of Topics	Spanish	3.58	2.17	1.63	1.85	19
Subtotal		3.19	1.94	1.14	1.70	32
Graphic Organizer	English	4.20	2.27	2.13	1.64	15
Graphic Organizer	Spanish	4.17	1.95	2.61	2.03	18
Subtotal		4.18	2.07	2.39	1.71	33
Total		3.69	2.02	1.90	0.20	65
Subtotal	Spanish	3.87	2.06	2.12	1.94	37
Subtotal	English	3.42	1.91	1.62	1.30	28

Information in Table 1 reveals that Gain 2 scores were lower than Gain 1 scores for all treatment groups. The reduction in gain scores reflects an expected decrease in the amount of information retained over time. Initial analysis indicated that in immediate and delayed recall tests, mean gain scores of both English and Spanish speaking groups using programs with embedded graphic organizers were higher than those achieved by their counterparts using programs with embedded lists of topics. These results lead us to believe, at least with descriptive statistics, that embedding graphic organizers in instructional programs is a better strategy to improve academic gains than embedding lists of topics in instructional programs for both Spanish and English speaking fourth-grade students.

Statistical and Educational Significance

Graphic organizers versus list of topics. From data in Table 1, the standardized mean difference effect size between groups was calculated using computer-based instructional programs with embedded graphic organizers and embedded list of topics. Effect sizes were identified to be 0.40 for Gain 1 scores and 0.51 for Gain 2 scores. An ANOVA was conducted for both Gain 1 and Gain 2 scores (see Table 2).

Table 2

Analysis of Variance: Comparison of Gain 1 and Gain 2 for English and Spanish Speakers Grouped by Program Type

Dependent Variable	Source	Degrees of Freedom	Sum of Squares	Mean Square	*F* test	Significance of one-tail *F* test
Gain 1	Between groups	1	16.06	16.06	3.99	*p* = .04
	Within groups	63	253.78	4.03		
	Total	64	269.84			
Gain 2	Between groups	1	15.84	15.85	5.32	*p* = .01
	Within groups	63	187.59	2.98		
	Total	64	203.44			

The information in Table 2 indicates that there was a statistically significant difference between treatment groups favoring graphic organizers on both short-term (Gain 1 scores) and long-term recall (Gain 2 scores). Previous researchers, as discussed earlier, indicated that graphic organizers within instructional material improved short-term and long-term information recall. Our findings support these conclusions. This experiment also extended research into the realm of computer-based instruction and elementary students. Evidence now exists which supports the idea that the use of graphic organizers in computer-based instructional programs has a significant positive effect on both short-term and long-term recall for fourth-grade students.

Dominant language differences. A two-way ANOVA was used to determine if the effectiveness of graphic organizers in computer-based instructional programs varied significantly by learner's dominant language. In this computation, program type and dominant language were used as independent variables and gain scores as the dependent variable. This analysis is shown in Table 3.

Table 3

Analysis of Variance: Comparison of Mean Scores for Graphic Organizer Users Grouped by Dominant Language

Dependent Variable	Source	Degrees of Freedom	Sum of Squares	Mean Square	*F* test	Significance of one-tail *F* test
Gain 1	Program	1	3.44	3.44	0.85	*p* = .03
	Language	1	18.74	18.74	4.64	*p* = .36
	Program X Language	1	3.95	3.95	0.97	*p* = .33
	Error	61	246.61	4.04		
Gain 2	Program	1	16.46	16.46	5.48	*p* = .02
	Language	1	4.23	4.23	1.41	*p* = .24
	Program X Language	1	0.02	0.02	0.01	*p* = .93
	Error	61	183.36			

Information presented in Table 3 indicates that there is no statistically significant difference at the 0.05 confidence level between language groups for the effect of graphic organizers in immediate (Gain 1) or delayed tests (Gain 2). These results indicate that the effectiveness of graphic organizers in computer-based instructional programs does not vary significantly by learner's dominant language. The standardized mean difference effect size calculated from Table 1 was 0.01 for Gain 1 scores and 0.19 for Gain 2 scores. These scores indicate that differences on the effect of graphic organizers between language groups are not educationally significant for either short-term or long-term recall.

Discussion

Implications of the Study

Two main implications can be deducted from the results of this study. First, the use of programs with embedded graphic organizers in computer-based instruction enhances short-term and long-term recall in fourth-grade students. The increase in academic achievement scores measuring long-term and short-term recall confirmed previous research findings. Second, results indicate that dominant language differences do not significantly impact the effectiveness of programs with embedded graphic organizers. The non-significant differences between dominant Spanish and dominant English speaking students were unexpected.

Researchers agree that the effectiveness of any learning strategy depends on context and content of instruction, and on individual learner's experience, cognitive maturity, motivation, and learning style (Oxford, 1990; Schmeck, 1983). In this study, context and content of instruction were analogous for all treatment groups. One assumption made was that subjects did not substantially differ in terms of their experience and cognitive maturity because they were at the same grade level, they were randomly assigned to treatment groups, and their pretest scores did not indicate statistically significant differences at the 0.05 level (Gimenez, 1994). Therefore, our results indicated that when using computer-based instructional programs with embedded graphic organizers, Spanish speaking and English speaking students, as groups, did not vary on leaning style to the point of significantly impacting academic achievement scores according to tests used in this study to measure short-term and long-term recall.

Theoreticians suggest that cultural background provides the most important resources for individual cognitive development (Connolly & Tucker, 1982; Stein, 1990; Sticht, 1992). Such resources refer to symbols and symbol systems, including natural language and conceptual knowledge. These are the primary tools for the transmission of cognitive abilities and motivational conditions (Sticht, 1992). Results of this study indicated that the different cultural backgrounds of dominant Spanish and dominant English speaking subjects did not significantly influence the effectiveness of graphic organizers embedded in computer-based instructional programs.

In searching for causes of academic achievement differences between dominant English and dominant Spanish speaking students, researchers determined differences in learning style preferences as key elements (Scarpaci & Fradd, 1985; Schaiper & Flores, 1985). These researchers suggested that culture strongly influences the way in which students learn and interact. Instead of faulting individual characteristics, studies on LEP and NELB native Spanish students identified that low scholastic achievement was related to instructional materials, instructional methods, classroom environments, and learning strategies that favor native English students (Dunn, 1990; Ulibarri, 1982). Recent studies determined that the United States educational system, at all levels of instruction, relies on the learning preferences of white middle-class students, and these preferences are not always shared by Mexican-Americans (Cohen, 1969; Connolly & Tucker, 1982). However, results of this study indicated that graphic organizers embedded in computer-based instructional programs significantly increased mean academic achievement scores of both groups, and did not significantly vary between dominant English and dominant Spanish speaking students.

Results of this study support previous theories suggesting that the use of graphic organizers is an effective strategy to increase short-term and long-term information recall. Although both groups had a decrease in Gain 2 scores reflecting long-term recall, this decrease was more pronounced for the group using programs with embedded list of topics. These results suggest that the use of computer-based instructional programs with embedded graphic organizers have their greatest impact on long-term recall. Although the study was limited to a one-shot 20 minute treatment, the results were significant. These findings, concluded from a single, short exposure to graphic organizers, foretell of potentially major cognitive growth in students who use this strategy for extended periods of time. Thus, educators and instructional designers can strongly encourage the use of embedded graphic organizers in instructional materials as means to enhance short-term and long-term recall of information.

Limitations of the Study

Given the characteristics of the study, several shortcomings are apparent. First, teachers did not monitor students during the treatment. It is possible that students did not complete the treatment or may have used the program assigned to a different group. However, data were consistent with previous studies. This consistency lends support to our conclusions. Second, the treatment was limited to a one-shot, 20-minute, computer-based instructional program. Although this short exposure was initially considered a weakness in our study design, it may also be viewed as supporting the strength of graphic organizers. Because students exhibited significant short- and long-term gains after a brief exposure, longer exposures to graphic organizers may generate even greater gains in academic scores.

Questions for Future Research

Questions and concerns for future research include the following:

1. Do graphic organizers embedded in computer-based instructional programs improve academic achievement scores when the graphics are used as navigation controls? This study focused on the use of graphic organizers as graphic representations of information. However, literature reveals that graphic organizers in computer-based instruction may also serve as navigational tools (Barba, 1993). The literature on learner control, however, is controversial. Some researchers suggest that because graphic organizers may be used as a nonlinear presentation controller, the impact on the instructional process may vary according to the learner's cognitive maturity, previous knowledge, learning style, and preferred leaning strategies. Researchers determined that although learner control is motivating, the lack of structure in the instructional sequence may cause barriers for some learners (Malone & Lepper, 1987).

2. Does the use of graphic organizers in computer-based instruction improve academic achievement scores when the organizers do not provide feedback on learner progress? Although this study focused on the use of graphic organizers as graphic representations of information, these organizers also served to provide feedback on learner progress. Feedback was provided by using colors to identify which concepts had just been explained, which were about to be viewed, and the overall structure of the lesson. Future research may replicate this study without the use of feedback to determine whether this feature was a critical variable for the effectiveness of graphic organizers in this study.

3. Does the use of graphic organizers in computer-based instruction improve academic achievement scores when they include labeled links? Explicitly labeling the relationships in a graphic organizer may cause information overload in students with lower cognitive capabilities. In this study, labeled relationships were avoided because it was assumed that they may impose extra cognitive processing leading to information overload for fourth-grade students. Researchers may want to compare the effectiveness of graphic organizers with and without labeled relationships with the population used in this study.

4. What are the characteristics of students who do not improve academic scores when they use computer-based instructional programs with embedded graphic organizers? A further study could identify characteristics of students who prefer to use lists of topics to graphic organizers by exposing learners to both strategies and allowing them to choose the strategy that has the greatest impact on their short-term and long-term recall (measured in terms of academic achievement scores). By identifying attributes of both groups of students, instruction could be tailored to better meet individual needs.

5. This study focused on Spanish and English speakers who are in a bilingual environment. Researchers may wish to replicate this study to include subjects in monolingual educational settings, and in settings with other than Spanish and English speakers.

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Keywords

Structural knowledge; Graphic Organizers; Sheltered English; Limited English Proficiency.

Title:

A Media Director and His Leadership: An Ethnographic Pilot Study

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Ethnography

An ethnography can be defined as an in-depth analytical description of an intact cultural scene. This research observes human behavior in its natural setting (holistic inquiry carried out in a natural setting) over a period of time. Naturalistic perspective emphasize humans as the primary data gathering instrument and the use of triangulated data-gathering procedures (Goetz & LeCompte, 1984). Human observation is flexible and can adapt to a complex situation as it evolves. In addition, human observation allows for the identification of biases that result from interactions and value differences between the "instrument" and the subject (Borg, 1989). To help reduce biases, researchers should use triangulation of data. Triangulation is the process of collecting and examining related documents to serve as crossreferences to observed data. Researchers using naturalistic inquiry purposely select their subject/group or setting. By purposeful selection, a qualitative researcher will be more likely to uncover the full array of "multiple realities" relevant to an inquiry. The focus of the ethnographer's inquiry is on the mundane, everyday practices of people. The paramount objective of qualitative research is understanding rather than generalizing or identifying cause and effect (Whitt, 1991).

Pilot Study

Research Design

This study was undertaken to explore the leadership qualities of a district media director. The school district, Byrdsville Public School District or BPS as school personnel referred to it (This is a pseudonym for the actual school district for confidentiality.), is a mid-sized school district with 26 school buildings and approximately 13,000 students. Using ethnographic research methods, the following questions were investigated:

What are the beliefs and values which underlies this media director's decisions?
What are the recurring events and practices of the media director?
What are the relationships that media director must cultivate?
What are the day-to-day encounters of a media director?
What are the leadership qualities of this media director?

The significance of this study revolves around the lack of any research on media directors. Research has been typically focused on either administrators (superintendents or principals) or teachers.

Data for this study were obtained through observation, interviews, and artifact analysis. Respondents were guaranteed confidentiality and all data presented in this study are designed to protect their anonymity.

Roles and Experiences of Investigator

During this study, I became a participant observer, an intern to the media director. My internship was contracted as one day a week, Tuesday, for two semesters so I could observe a full school year cycle. In addition, I attended special events I was invited to. By being actively involved in the situation being observed, insights and interpersonal relationships developed which would have been virtually impossible to achieve through any other method. This role, participant observer, requires the researcher to come to the situation as a learner and to try, at least partially, to be socialized into the group. The socialization process allows the researcher to experience the physical, relational, and emotional realities of the setting as it exists for the members (Dobbert, 1984).

In the beginning as a participant observer, Dobbert (1984) recommends the researcher keep in the background, keep quiet, watch, and listen. In addition, the researcher should be maintaining a friendly and willing stance, offering to assist with single or onerous tasks, accepting invitations and assistance gratefully, asking questions when you don't think it would be bothersome, and trying to learn the language of the group (Dobbert, 1984).

Wolcott (1988) warns that taking a more active role than the "observer" has costs attached; research efforts are sometimes secondary to the participation. However, the benefits of being a participant-observer includes: 1) quality of direct on-site observation; with the participant, long term observation and group acceptance is more likely to occur; 2) freedom of access; more documents and subjects are available to the researcher when she or he is a "part" of the group; 3) intensity of observation; by being in the "loop" there are typically more hours of observation, increasing the chances of observing the common and the exceptional; and 4) data sampling; by being a participant, the researcher may be included in meetings (formal and informal) and be included in mailings that she or he would not have known about otherwise (Borg, 1989).

Data Collection Methods

"Ethnographers consider data to be potentially verifiable information obtained from the environment. The problem of data collection, then, consists of defining appropriate information and developing strategies for obtaining it" (Goetz & LeCompte, 1984, p. 107). The most common data collection includes observation, interviewing, researcher-designed instruments, and content analysis of human artifacts (Goetz & LeCompte, 1984).

Interactions and observations were the primary sources for the field notes in this study. Within these activities are discussions relative to the media director's position. With each observation I became more at ease discriminating between what should and should not be recorded, knowing what I left out shaped my data as certainly as that which I included. During observations I would jot down notes and quotes. Later, these would be rewritten, expanding my description of the experience.

In addition to the field notes, informal interviews were conducted with the media director, secretaries, media specialists, and principals. I used interviewing methods to "get at" the reasons for certain actions I had observed or "get to" the individual's opinion, background, and experiences. These interviews ensured a variety of perspectives and consistency of data.

Correspondence or documents relating to the media director were collected in efforts to cross-reference to the observed data. These artifacts were typical correspondence of the media director, letters and memos that were sent within and outside of the district. In addition, I collected original material Pete created for specific groups (media specialists, secretaries, district coordinators, district technology group). This process allowed for triangulation and a "trustworthiness" of the data (Lincoln & Guba, 1985).

Respondents

Following Lincoln & Guba's (1985) suggestion, purposeful sampling was employed in order to obtain as much information as possible and to get the maximum variation in sampling. Further, the intended purpose of data collection was not to generate enough data to be able to draw conclusions or generalizations but to be able to provide results with the uniqueness of the subject or phenomenon (Lincoln & Guba, 1985).

All respondents in this pilot study were employed by Byrdsville Public School District. Every respondent was told they would have anonymity and all information would be confidential. Furthermore, each respondent was given a pseudonym either by choosing it herself/himself or one was provided by the researcher in order to maintain confidentiality. Respondents who volunteered to be observed and to interviews included:

Media director: Dr. Pete Young
Microcomputer coordinator: Bob
Media specialists: Sharon, Laura, Brenda
Principal: Paul
Secretaries: Nancy, Elizabeth, Frances, Susan

In addition, there were many individuals who were a part of the project because of their interactions with Pete. I was introduced as "his intern who is learning how a media program works."

Analysis

Data does not answer research questions; it must be analyzed before a scientific perspective can be offered. Lincoln & Guba (1985) promote the induction and constant comparison method of data analysis. Dobbert's (1984) description of Darwinian natural history method follows this same research strategy. The method includes five steps and is a spiral process. The five steps are: 1) careful observation, 2) have a conceptual scheme into which to try and fit the data (this occurs with step 1), 3) change the concepts, assumptions, or hypotheses to accommodate the facts (this occurs after step 1), 4) group facts by categories and arrive at conclusions by explaining the relationships or processes that create the differences and similarities expressed in the categories (this occurs with step 3), and 5) turn to a new observation directed by the discoveries stemming from the analytic process as carried out through the previous four steps (Dobbert, 1984).

Data were analyzed and categorized into issues which describe the inter-relatedness of theory and the decision making / actions of the media director. The themes of the study are presented in the following two sections: 1) Leadership: Lead, Follow, or Please Retire!, 2) Communication: The Way I Hear It.

Literature Review: Leadership

Leadership is a process whereby one person exerts social influence over the members of the group. A leader is a person with power over others who exercises this power for the purpose of influencing their behavior (Heller, Van Till & Zurcher, 1986). Today, leaders are challenged as they find themselves working with more individuals who are different from themselves and they must bridge the empathy gap. A leader's creativity must be used when working with the resources of their diverse team members and avoid neglecting the team members' important skills and competencies.

Educational technology leadership shares much with the research on leadership. However, the specific knowledge and abilities connected with technology provides for unique considerations. An analysis of the effectiveness of technology in education suggests that the manner in which technology is implemented is more important than any intrinsic characteristics of the technology (Kearsley & Lynch, 1992). Leadership plays a very critical role in the process of the adoption of technology.

Technology leaders today are expected to possess strong visionary skills, have excellent interpersonal and communication skills, as well as a measure of technical competence in addition to the "basic leadership" capabilities (Ray, 1992). To be successful, these leaders must be successful in their abilities to articulate and influence cultural norms and values; they are expected to shape the culture of the school by creating a new vision that members can believe in and act upon (Kearsley & Lynch, 1992).

Electronic technology has been viewed as a radical departure from the traditional educational technologies (books, chalkboards, duplicating machines, teaching systems, ect.). The new technology has only been widely available or affordable since the mid 1980's. Therefore, the majority of teachers did not have the opportunity to practice with electronic technology during their preprofessional training. Teachers are typically insecure and unskilled in regards to using technology in their classroom and mandates to use technology by administrators only leave them frustrated and floundering

The failure of any technology can result for a variety of reasons. Some of these reasons can include lack of teacher training, lack of appropriate materials/equipment, poorly conceived implementation plans, unrealistic goals/expectations, or insufficient funding. Most of these pitfalls can be corrected with good technological leadership. Technology leaders must identify educational problems which technology can solve and build theoretical, political, and financial support structures to ensure success (Kearsley & Lynch, 1992).

Lead, Follow, or Please Retire

The first time I was in Pete's office, was to discuss my internship with him. Pete's office is located in an old brick school building called Smith by the district. Smith is located in the center of the city and is surrounded by federal assistance housing projects. The east side of Smith is its architectural front and has a large green yard between it and a major street. The drive entrance is located behind the building with a small paved parking lot at the south end of the building and a six foot fence on the perimeter of the property. The doors coming into the building from the parking lot are the doors used primarily by the Instructional Materials Services (IMS) department. The other half of the building is occupied by the alternative high school. A high school for students who could or would not "fit" into the district's traditional high schools.

Upon entering from the parking lot there is a hundred yard walk down a dimly light hallway filled with furniture and/or equipment, depending of the current activities of IMS, to Pete's office. His office reflects its age by the height of the ceiling, the light fixtures, exposed plumbing, and dilapidated walls. The rectangular office is painted yellow. Yellow is considered a positive, warm color; it is also the color disliked by the most people (Raines, 1989). With his desk facing the entrance of the office, there are four, six foot high windows behind him that create a halo effect with the afternoon sunshine. A round table and four chairs occupy the front of the office.

A man of middle years, athletic build, blond hair, blue eyes, and a smile met me. Pete was on his was across the hall to talk to one of four secretaries who work at IMS. "Go on in and have a seat, I'll be with you in a sec" and Pete was off leaving me to ponder what I was volunteering for.

Pete's leadership style is participatory. Sharon, a media specialist, summed it up this way when we were setting up a new media center, "People respect Pete because there isn't anything he won't do. Today for example he's helping put up shelves and shelving books. You don't find many administrators willing to do that." When ask about what he expects from employees, Pete responded, "I try to be a model in my work. I model what I want them to be doing for me [library and technology related] . . . I don't expect anything more from them than I do from myself."

Pete describes his position in the following way, "I'm a facilitator. I get people together in order to make things happen. I help solve problems. I look ahead to our needs." He is described by most all of the elementary media specialists as a "good leader" (some say boss) and those answering always added "I like Pete." What is a good leader / boss? To the media specialists I spoke with it means someone they can count on when they are in a pinch, someone to help them keep up in their profession, someone to brainstorm with, someone to help provide direction, and someone to talk things over with.

The media specialists like Pete as a person, but as Heller, Van Til, & Zurcher (1986) points out a leader's "authority must be defined in terms of the follower's acceptance of the legitimacy of the influence attempt" (p. 6). From conversations with the media specialists, the following concerns were voiced. "He's always so busy. I don't call him anymore unless it's a real problem." "Pete has been an administrator for so long he doesn't really know what's happening in the schools, or what we really do." "I think Pete has gotten his head bumped once too often and has pulled back we don't try enough different ways or things anymore." Nested within these comments are their concerns regarding Pete's leadership.

"Leader and follower must be united by common goals and aspirations and by a will to lead, on one side, and a will to follow on the other. The leader must be a member of the group, and must share its norms, its objectives, and its aspirations" (Heller, Van Til, & Zurcher, 1986, p.6). He is described by most all of the elementary media specialists as a "good leader." However, Pete's relationship with the secondary media specialists is very different.

The secondary media specialists are not willing followers of Pete. For example, Laura did not view Pete as her supervisor, "He is a coordinator and a facilitator for the secondary people. My supervisor and boss is my principal." Pete believes he is more than what she described but remains optimistic, "Remember, they didn't have anyone in my position before I came on board [as director]. So for some of those people it has been a real adjustment [to view him as a leader and not a member]. . . . That will change. You evolve. Some of those people will retire and you hire others to fit more in the niche." Pete's philosophy coincides with Heller, Van Til, & Zurcher's postulate (1986, p. 254), "Good leadership enhances followers, just as good followership enhances leaders." By attempting to hire personnel in line with his values and beliefs, Pete is strengthening his position and programs within the district.

Most days meetings take up 70 percent of Pete's day. He meets with "his boss and his boss' boss," with principals, with vendors, with media specialists, with coordinators, with teachers, with University representatives, with partners in education representatives, with parents, with students, and with a variety of "outsiders" who are interested in BPS' technology. "My job is meetings!" Pete proclaimed one day after an unusually long meeting.

Meetings are bureaucratic by nature, but there is no way around them in any social structure. However, Pete attends meetings with the common good of the district at the top of his agenda. He goes into the meetings with the plan to do what is best for the district or department based on what the students of the district need or deserve. Pete feels he has a stake in the educational process as he has two daughters in the district. Before he makes any decision or votes on any action, Pete stated he asks himself "How will this help the students, the district?

Pete's technology leadership is on cue with the literature regarding his creativity, his technical know how, and his visionary focus for the district (Kearsley & Lynch, 1992). A result of Pete's visionary skills is now tangible in all buildings. He believed card catalogs were obsolete and should be replaced with automation. Every media center in the district has an automated card catalog for students and faculty. The students and faculty I observed were very comfortable with the technology and the specialists say the students use it more than they ever did the card catalogs. In addition, the specialist state students are finding and using more resources for their classroom reports. Another visionary resource that is visible in all of the schools is CD-ROM workstations. Pete believes students will be required to remember less facts but to know were to find the key-information they need just as adults are now doing in the workplace. These are not truly revolutionary ideas because these resources have been available to the adult population for some time, but are an "evolution" in order to keep up with the outside world. BPS is one of the few school districts that has put these resources into all buildings, not just magnet schools.

Literature Review: Communication

Each person's life is lived as a series of conversations. Tannen (1990) states men's conversational style reflects their attitudes regarding life; it is a contest, a struggle to preserve independence and avoid failure. Conversations are negotiations in which people try to achieve and maintain the upper hand if they can. Men's conversations are efforts to protect themselves from others' attempt to put them down and push them around.

Like men, women's conversational style reflect their own attitude towards life; it is a struggle to preserve intimacy and avoid isolation. Conversations are negotiations for closeness in which people try to seek and give confirmation and support, and to reach consensus (Tannen, 1990). Women attempt to protect themselves from others' attempts to push them away.

Each style is valid on its own terms, misunderstandings arise because the styles are different. We all want, above all, to be heard, but not merely to be heard. We want to be understood, heard for what we think we are saying and for what we know we meant. Women and men are both often frustrated by other's way of responding to their expression of troubles.

Many men see themselves as problem solvers and a complaint or trouble is a challenge to their ablity to find a solution. If women resent men's tendency to offer solutions to problems, men complain about women's refusal to take action to solve problems they complain about. Many women who habitually report problems at work or in friendships, the message is not one of complaint but is a bid for an expression of understanding - we are the same, you are not alone (Tannen, 1990).

The Way I Hear It

Deborah Tannen (1990) states women and men have characteristically different conversational styles and feels that gender differences account for these contrasting styles. At all ages, females are more likely to phrase their preferences as suggestions, appearing to give others options in deciding what to do. In addition, women try to influence others by making polite suggestions. Men use more direct commands in most all situations (Tannen, 1990). It is these differences in styles that give rise to many female/male conflicts. People with direct styles of conversation, typically men, perceive indirect requests, typically women, as manipulative or whiny.

The direct conversation style is very evident with Pete in all methods of communication. Pete is brief and direct with his conversations, having few non-business conversations. For meetings he is responsible for running, Pete always has a typed outline to hand out to the members and he follows it very closely. Pete states he has to follow agendas in order to keep meetings on track and on time. Many times Pete has meetings back to back and can not afford time over runs.

In professional phone conversations Pete is very consistent in his delivery, he introduces himself (Hello, this is Pete Young-he will add the Dr. title when dealing with people outside of the district) and follows with "I'm calling about . . . ." He will, after the business has been conducted and depending on his schedule, make small talk for a few minutes with the person on the other end of the line. He concludes his conversations with "Well-thanks a lot. Bye."

In conversations with media specialists regarding the quality of their communication with Pete I was told he was a "very good listener, most of the time." However, one specialist added the following: "He is a male boss and he doesn't understand where we're coming from (female perspective). He doesn't deal well with the whiners."

Pete's main complaint regarding other district personnel, including several of the media specialists (all media specialists were female), was their socializing, "They're always entertaining someone." Tannen (1990) explains women mix business and personal talk to establish a comfortable working relationship and are thus viewed as socializing by those with the direct approach. Women believe the personal talk makes it possible for them to conduct their business successfully and efficiently (Tannen, 1990).

Indirect methods of communication that act to nurture relationships are often viewed as socializing and therefore those individuals are perceived as not doing their job or as not taking their job seriously by people who use the direct method. An example of communication methods creating incorrect assumptions about another individual involves Laura, a secondary media specialist and Pete. I observed Laura giving a tour to visitors from another school district. She showed them around the media center at the school she was employed at, pointed out the various technologies available and the reasons the district supported those technologies in the schools. Laura addressed their questions regarding all aspects of technology used and those she could not answer encouraged them to call and talk with Pete. She was an excellent ambassador for the district and for the use of technology in school media centers. However, Pete perceives Laura as a socialite and as someone who "just sits in her office waiting to retire."

Observations

A media director should be an administrative position who orchestrates the use of technology within the school district. The duties and responsibilities of the media director evolve as the district's climate and resources do. Regarding his own definition of his position, Pete fluctuates. For example, when asked what it is he does, the first descriptor Pete uses is facilitator, yet, he is frustrated by the secondary media specialists for viewing him in this light.

Pete is a leader, promoted from the ranks of media specialists. However, his administrative duties have caused him some "followship" difficulties and he has opted to "wait them [media specialists] out." A leader's legitimacy is defined by the followers' acceptance of him as a leader and of him as a part of the group. As Pete waits for his position to become legitimate, he becomes less a member of the group he leads.

As director, Pete must have effective communication skills. However without conscientiously realizing it, gender has played a part in his attitude and dealings with several of the media specialists. Pete uses the direct method of communication, which is typical of men. Most of the medial specialists used the indirect approach, which is typical of women. Pete's perceptions of many of the media specialists as "socialites" and "time wasters" are a direct result of the two modes of communications.

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Title:

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During this study, I became a participant observer, an intern to the media director. My internship was contracted as one day a week, Tuesday, for two semesters so I could observe a full school year cycle. In addition, I attended special events I was invited to. By being actively involved in the situation being observed, insights and interpersonal relationships developed which would have been virtually impossible to achieve through any other method. This role, participant observer, requires the researcher to come to the situation as a learner and to try, at least partially, to be socialized into the group. The socialization process allows the researcher to experience the physical, relational, and emotional realities of the setting as it exists for the members (Dobbert, 1984).

In the beginning as a participant observer, Dobbert (1984) recommends the researcher keep in the background, keep quiet, watch, and listen. In addition, the researcher should be maintaining a friendly and willing stance, offering to assist with single or onerous tasks, accepting invitations and assistance gratefully, asking questions when you don't think it would be bothersome, and trying to learn the language of the group (Dobbert, 1984).

Wolcott (1988) warns that taking a more active role than the "observer" has costs attached; research efforts are sometimes secondary to the participation. However, the benefits of being a participant-observer includes: 1) quality of direct on-site observation; with the participant, long term observation and group acceptance is more likely to occur; 2) freedom of access; more documents and subjects are available to the researcher when she or he is a "part" of the group; 3) intensity of observation; by being in the "loop" there are typically more hours of observation, increasing the chances of observing the common and the exceptional; and 4) data sampling; by being a participant, the researcher may be included in meetings (formal and informal) and be included in mailings that she or he would not have known about otherwise (Borg, 1989).

Data Collection Methods

"Ethnographers consider data to be potentially verifiable information obtained from the environment. The problem of data collection, then, consists of defining appropriate information and developing strategies for obtaining it" (Goetz & LeCompte, 1984, p. 107). The most common data collection includes observation, interviewing, researcher-designed instruments, and content analysis of human artifacts (Goetz & LeCompte, 1984).

Interactions and observations were the primary sources for the field notes in this study. Within these activities are discussions relative to the media director's position. With each observation I became more at ease discriminating between what should and should not be recorded, knowing what I left out shaped my data as certainly as that which I included. During observations I would jot down notes and quotes. Later, these would be rewritten, expanding my description of the experience.

In addition to the field notes, informal interviews were conducted with the media director, secretaries, media specialists, and principals. I used interviewing methods to "get at" the reasons for certain actions I had observed or "get to" the individual's opinion, background, and experiences. These interviews ensured a variety of perspectives and consistency of data.

Correspondence or documents relating to the media director were collected in efforts to cross-reference to the observed data. These artifacts were typical correspondence of the media director, letters and memos that were sent within and outside of the district. In addition, I collected original material Pete created for specific groups (media specialists, secretaries, district coordinators, district technology group). This process allowed for triangulation and a "trustworthiness" of the data (Lincoln & Guba, 1985).

Respondents

Following Lincoln & Guba's (1985) suggestion, purposeful sampling was employed in order to obtain as much information as possible and to get the maximum variation in sampling. Further, the intended purpose of data collection was not to generate enough data to be able to draw conclusions or generalizations but to be able to provide results with the uniqueness of the subject or phenomenon (Lincoln & Guba, 1985).

All respondents in this pilot study were employed by Byrdsville Public School District. Every respondent was told they would have anonymity and all information would be confidential. Furthermore, each respondent was given a pseudonym either by choosing it herself/himself or one was provided by the researcher in order to maintain confidentiality. Respondents who volunteered to be observed and to interviews included:

Media director: Dr. Pete Young
Microcomputer coordinator: Bob
Media specialists: Sharon, Laura, Brenda
Principal: Paul
Secretaries: Nancy, Elizabeth, Frances, Susan

In addition, there were many individuals who were a part of the project because of their interactions with Pete. I was introduced as "his intern who is learning how a media program works."

Analysis

Data does not answer research questions; it must be analyzed before a scientific perspective can be offered. Lincoln & Guba (1985) promote the induction and constant comparison method of data analysis. Dobbert's (1984) description of Darwinian natural history method follows this same research strategy. The method includes five steps and is a spiral process. The five steps are: 1) careful observation, 2) have a conceptual scheme into which to try and fit the data (this occurs with step 1), 3) change the concepts, assumptions, or hypotheses to accommodate the facts (this occurs after step 1), 4) group facts by categories and arrive at conclusions by explaining the relationships or processes that create the differences and similarities expressed in the categories (this occurs with step 3), and 5) turn to a new observation directed by the discoveries stemming from the analytic process as carried out through the previous four steps (Dobbert, 1984).

Data were analyzed and categorized into issues which describe the inter-relatedness of theory and the decision making / actions of the media director. The themes of the study are presented in the following two sections: 1) Leadership: Lead, Follow, or Please Retire!, 2) Communication: The Way I Hear It.

Literature Review: Leadership

Leadership is a process whereby one person exerts social influence over the members of the group. A leader is a person with power over others who exercises this power for the purpose of influencing their behavior (Heller, Van Till & Zurcher, 1986). Today, leaders are challenged as they find themselves working with more individuals who are different from themselves and they must bridge the empathy gap. A leader's creativity must be used when working with the resources of their diverse team members and avoid neglecting the team members' important skills and competencies.

Educational technology leadership shares much with the research on leadership. However, the specific knowledge and abilities connected with technology provides for unique considerations. An analysis of the effectiveness of technology in education suggests that the manner in which technology is implemented is more important than any intrinsic characteristics of the technology (Kearsley & Lynch, 1992). Leadership plays a very critical role in the process of the adoption of technology.

Technology leaders today are expected to possess strong visionary skills, have excellent interpersonal and communication skills, as well as a measure of technical competence in addition to the "basic leadership" capabilities (Ray, 1992). To be successful, these leaders must be successful in their abilities to articulate and influence cultural norms and values; they are expected to shape the culture of the school by creating a new vision that members can believe in and act upon (Kearsley & Lynch, 1992).

Electronic technology has been viewed as a radical departure from the traditional educational technologies (books, chalkboards, duplicating machines, teaching systems, ect.). The new technology has only been widely available or affordable since the mid 1980's. Therefore, the majority of teachers did not have the opportunity to practice with electronic technology during their preprofessional training. Teachers are typically insecure and unskilled in regards to using technology in their classroom and mandates to use technology by administrators only leave them frustrated and floundering

The failure of any technology can result for a variety of reasons. Some of these reasons can include lack of teacher training, lack of appropriate materials/equipment, poorly conceived implementation plans, unrealistic goals/expectations, or insufficient funding. Most of these pitfalls can be corrected with good technological leadership. Technology leaders must identify educational problems which technology can solve and build theoretical, political, and financial support structures to ensure success (Kearsley & Lynch, 1992).

Lead, Follow, or Please Retire

The first time I was in Pete's office, was to discuss my internship with him. Pete's office is located in an old brick school building called Smith by the district. Smith is located in the center of the city and is surrounded by federal assistance housing projects. The east side of Smith is its architectural front and has a large green yard between it and a major street. The drive entrance is located behind the building with a small paved parking lot at the south end of the building and a six foot fence on the perimeter of the property. The doors coming into the building from the parking lot are the doors used primarily by the Instructional Materials Services (IMS) department. The other half of the building is occupied by the alternative high school. A high school for students who could or would not "fit" into the district's traditional high schools.

Upon entering from the parking lot there is a hundred yard walk down a dimly light hallway filled with furniture and/or equipment, depending of the current activities of IMS, to Pete's office. His office reflects its age by the height of the ceiling, the light fixtures, exposed plumbing, and dilapidated walls. The rectangular office is painted yellow. Yellow is considered a positive, warm color; it is also the color disliked by the most people (Raines, 1989). With his desk facing the entrance of the office, there are four, six foot high windows behind him that create a halo effect with the afternoon sunshine. A round table and four chairs occupy the front of the office.

A man of middle years, athletic build, blond hair, blue eyes, and a smile met me. Pete was on his was across the hall to talk to one of four secretaries who work at IMS. "Go on in and have a seat, I'll be with you in a sec" and Pete was off leaving me to ponder what I was volunteering for.

Pete's leadership style is participatory. Sharon, a media specialist, summed it up this way when we were setting up a new media center, "People respect Pete because there isn't anything he won't do. Today for example he's helping put up shelves and shelving books. You don't find many administrators willing to do that." When ask about what he expects from employees, Pete responded, "I try to be a model in my work. I model what I want them to be doing for me [library and technology related] . . . I don't expect anything more from them than I do from myself."

Pete describes his position in the following way, "I'm a facilitator. I get people together in order to make things happen. I help solve problems. I look ahead to our needs." He is described by most all of the elementary media specialists as a "good leader" (some say boss) and those answering always added "I like Pete." What is a good leader / boss? To the media specialists I spoke with it means someone they can count on when they are in a pinch, someone to help them keep up in their profession, someone to brainstorm with, someone to help provide direction, and someone to talk things over with.

The media specialists like Pete as a person, but as Heller, Van Til, & Zurcher (1986) points out a leader's "authority must be defined in terms of the follower's acceptance of the legitimacy of the influence attempt" (p. 6). From conversations with the media specialists, the following concerns were voiced. "He's always so busy. I don't call him anymore unless it's a real problem." "Pete has been an administrator for so long he doesn't really know what's happening in the schools, or what we really do." "I think Pete has gotten his head bumped once too often and has pulled back we don't try enough different ways or things anymore." Nested within these comments are their concerns regarding Pete's leadership.

"Leader and follower must be united by common goals and aspirations and by a will to lead, on one side, and a will to follow on the other. The leader must be a member of the group, and must share its norms, its objectives, and its aspirations" (Heller, Van Til, & Zurcher, 1986, p.6). He is described by most all of the elementary media specialists as a "good leader." However, Pete's relationship with the secondary media specialists is very different.

The secondary media specialists are not willing followers of Pete. For example, Laura did not view Pete as her supervisor, "He is a coordinator and a facilitator for the secondary people. My supervisor and boss is my principal." Pete believes he is more than what she described but remains optimistic, "Remember, they didn't have anyone in my position before I came on board [as director]. So for some of those people it has been a real adjustment [to view him as a leader and not a member]. . . . That will change. You evolve. Some of those people will retire and you hire others to fit more in the niche." Pete's philosophy coincides with Heller, Van Til, & Zurcher's postulate (1986, p. 254), "Good leadership enhances followers, just as good followership enhances leaders." By attempting to hire personnel in line with his values and beliefs, Pete is strengthening his position and programs within the district.

Most days meetings take up 70 percent of Pete's day. He meets with "his boss and his boss' boss," with principals, with vendors, with media specialists, with coordinators, with teachers, with University representatives, with partners in education representatives, with parents, with students, and with a variety of "outsiders" who are interested in BPS' technology. "My job is meetings!" Pete proclaimed one day after an unusually long meeting.

Meetings are bureaucratic by nature, but there is no way around them in any social structure. However, Pete attends meetings with the common good of the district at the top of his agenda. He goes into the meetings with the plan to do what is best for the district or department based on what the students of the district need or deserve. Pete feels he has a stake in the educational process as he has two daughters in the district. Before he makes any decision or votes on any action, Pete stated he asks himself "How will this help the students, the district?

Pete's technology leadership is on cue with the literature regarding his creativity, his technical know how, and his visionary focus for the district (Kearsley & Lynch, 1992). A result of Pete's visionary skills is now tangible in all buildings. He believed card catalogs were obsolete and should be replaced with automation. Every media center in the district has an automated card catalog for students and faculty. The students and faculty I observed were very comfortable with the technology and the specialists say the students use it more than they ever did the card catalogs. In addition, the specialist state students are finding and using more resources for their classroom reports. Another visionary resource that is visible in all of the schools is CD-ROM workstations. Pete believes students will be required to remember less facts but to know were to find the key-information they need just as adults are now doing in the workplace. These are not truly revolutionary ideas because these resources have been available to the adult population for some time, but are an "evolution" in order to keep up with the outside world. BPS is one of the few school districts that has put these resources into all buildings, not just magnet schools.

Literature Review: Communication

Each person's life is lived as a series of conversations. Tannen (1990) states men's conversational style reflects their attitudes regarding life; it is a contest, a struggle to preserve independence and avoid failure. Conversations are negotiations in which people try to achieve and maintain the upper hand if they can. Men's conversations are efforts to protect themselves from others' attempt to put them down and push them around.

Like men, women's conversational style reflect their own attitude towards life; it is a struggle to preserve intimacy and avoid isolation. Conversations are negotiations for closeness in which people try to seek and give confirmation and support, and to reach consensus (Tannen, 1990). Women attempt to protect themselves from others' attempts to push them away.

Each style is valid on its own terms, misunderstandings arise because the styles are different. We all want, above all, to be heard, but not merely to be heard. We want to be understood, heard for what we think we are saying and for what we know we meant. Women and men are both often frustrated by other's way of responding to their expression of troubles.

Many men see themselves as problem solvers and a complaint or trouble is a challenge to their ablity to find a solution. If women resent men's tendency to offer solutions to problems, men complain about women's refusal to take action to solve problems they complain about. Many women who habitually report problems at work or in friendships, the message is not one of complaint but is a bid for an expression of understanding - we are the same, you are not alone (Tannen, 1990).

The Way I Hear It

Deborah Tannen (1990) states women and men have characteristically different conversational styles and feels that gender differences account for these contrasting styles. At all ages, females are more likely to phrase their preferences as suggestions, appearing to give others options in deciding what to do. In addition, women try to influence others by making polite suggestions. Men use more direct commands in most all situations (Tannen, 1990). It is these differences in styles that give rise to many female/male conflicts. People with direct styles of conversation, typically men, perceive indirect requests, typically women, as manipulative or whiny.

The direct conversation style is very evident with Pete in all methods of communication. Pete is brief and direct with his conversations, having few non-business conversations. For meetings he is responsible for running, Pete always has a typed outline to hand out to the members and he follows it very closely. Pete states he has to follow agendas in order to keep meetings on track and on time. Many times Pete has meetings back to back and can not afford time over runs.

In professional phone conversations Pete is very consistent in his delivery, he introduces himself (Hello, this is Pete Young-he will add the Dr. title when dealing with people outside of the district) and follows with "I'm calling about . . . ." He will, after the business has been conducted and depending on his schedule, make small talk for a few minutes with the person on the other end of the line. He concludes his conversations with "Well-thanks a lot. Bye."

In conversations with media specialists regarding the quality of their communication with Pete I was told he was a "very good listener, most of the time." However, one specialist added the following: "He is a male boss and he doesn't understand where we're coming from (female perspective). He doesn't deal well with the whiners."

Pete's main complaint regarding other district personnel, including several of the media specialists (all media specialists were female), was their socializing, "They're always entertaining someone." Tannen (1990) explains women mix business and personal talk to establish a comfortable working relationship and are thus viewed as socializing by those with the direct approach. Women believe the personal talk makes it possible for them to conduct their business successfully and efficiently (Tannen, 1990).

Indirect methods of communication that act to nurture relationships are often viewed as socializing and therefore those individuals are perceived as not doing their job or as not taking their job seriously by people who use the direct method. An example of communication methods creating incorrect assumptions about another individual involves Laura, a secondary media specialist and Pete. I observed Laura giving a tour to visitors from another school district. She showed them around the media center at the school she was employed at, pointed out the various technologies available and the reasons the district supported those technologies in the schools. Laura addressed their questions regarding all aspects of technology used and those she could not answer encouraged them to call and talk with Pete. She was an excellent ambassador for the district and for the use of technology in school media centers. However, Pete perceives Laura as a socialite and as someone who "just sits in her office waiting to retire."

Observations

A media director should be an administrative position who orchestrates the use of technology within the school district. The duties and responsibilities of the media director evolve as the district's climate and resources do. Regarding his own definition of his position, Pete fluctuates. For example, when asked what it is he does, the first descriptor Pete uses is facilitator, yet, he is frustrated by the secondary media specialists for viewing him in this light.

Pete is a leader, promoted from the ranks of media specialists. However, his administrative duties have caused him some "followship" difficulties and he has opted to "wait them [media specialists] out." A leader's legitimacy is defined by the followers' acceptance of him as a leader and of him as a part of the group. As Pete waits for his position to become legitimate, he becomes less a member of the group he leads.

As director, Pete must have effective communication skills. However without conscientiously realizing it, gender has played a part in his attitude and dealings with several of the media specialists. Pete uses the direct method of communication, which is typical of men. Most of the medial specialists used the indirect approach, which is typical of women. Pete's perceptions of many of the media specialists as "socialites" and "time wasters" are a direct result of the two modes of communications.

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Title:

Providing Computer Conferencing Opportunities for Minority Students and Measuring the Results

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Problem Statement

Members of minority groups come to college, especially community colleges, with varying levels of computer experience, but generally speaking, their experience is not as extensive as that brought by non-minority students. This initial imbalance has both immediate and long-range effects on minority students' academic success and their eventual career opportunities. However, institutions of higher education, especially community colleges, can develop programs to address these initial inequities. This paper reviews the research on the effects of differential computer background on the short- and long-range success of minority students, identifies some strategies Glendale Community College has used to encourage minority students' use of computing, specifically computer conferencing, and explains the measures constructed to track institutional progress in providing equal access.

Background

Researchers have identified a number of social and economic reasons why minority students leave the secondary schools with less computer experience than non-minority students. Issues of access dominate (Neuman, 1991). Students build their expertise by spending regular and extensive time on computers, so the ratio of students to computers is critical. In addition, they develop a sense of self-efficacy by succeeding in computing tasks and watching others like themselves succeeding also (Olivier & Shapiro, 1993). While many schools have inadequate numbers of classroom computers, minority students are less likely to have alternative access points, either at home or in public libraries where they can supplement the computer time provided at school (Resta, 1992). In schools, more aggressive students are likely to monopolize computer use; they frequently have access to more sophisticated programs and more extensive resources like the Internet. Conversely, minority students, because they are often at-risk, are frequently directed towards the use of "explicit-goal" software, the use of which, according to Stanley Pogrow, causes the learning gap between them and other students to widen (1993).

A number of cultural issues affect minority students' ability to develop extensive computer expertise. Often instruction in computing is linked to math and science instruction; if minority students proceed more slowly in these content areas, they will also proceed more slowly in developing computer skills (Martin & Hearne, 1989; Olivier & Shapiro, 1993). In fact, the kinds of computing activities available in the past for students have fallen into a restricted range, one tied more closely to majority culture than to the interests of members of minority groups (Lucas & Schecter, 1992). In addition, in most computer labs, few mentors and role models exist for minority students. Finally, many teachers view computing hierarchically, reserving it for those students who have mastered other skills perceived as more "basic" (Yellin & Koetting, 1988). Consequently, minority students, over their secondary school careers, may not develop equivalent levels of computer competence as their non-minority peers.

When minority students enter college with less computer experience, they can feel the effects almost immediately. Any perceived inadequacy, whether it is in preparation, experience, or skill level, contributes to the ease with which students are willing to drop out. But differing levels of computer experience have measurable effects on students' ability to complete assigned work in a timely and efficient manner (Resta, 1992). Students with well-developed computer skills know how to use various productivity tools like spreadsheets, databases, and word processors, and recognize their benefits. In addition, they may know how to use the Internet to retrieve up-to-date or obscure information. Students who neither have access to the tools nor have prior experience using them may spend their available time doing mechanical tasks manually, running out of time (and energy) before they get to more intellectually rewarding activities. Lack of computer experience, especially with networked resources, may close off opportunities for developing improved literacy skills, and lack of familiarity with computer environments may hamper minority students when they encounter technologically-rich educational activities like simulations (Yellin & Koetting, 1988). In addition to inhibiting students' academic success, lack of computer experience can close off opportunities for career development, and thus restrict minority students' chances of long-term economic success (Badagliacco, 1990).

Local Strategies

All institutions of higher education, but especially community colleges, have responsibility for fostering increased educational access and for ensuring opportunities for success for minority students. In part, they can do this by encouraging students to increase their level of computer expertise, both before and after they come to college. Glendale Community College has provided extensive computing facilities and a variety of user environments so that members of minority groups can gain easy access and learn in a hospitable climate. However, perceived availability of resources may not translate into actual use. Second, computing activities have been linked with activities across instructional levels and throughout the curriculum, so that lack of progress in one academic area does not preclude the development of computing expertise. In addition, this campus has provided different kinds of computer-mediated environments in order to tap different kinds of learning skills demonstrated by students with a variety of cultural backgrounds. It has provided a variety of computer-mediated communication opportunities, especially ones that take into account backgrounds in oral culture, where students have been able to practice their own literacy skills by reading and writing on topics that relate to their own interests and heritage. Finally, GCC has placed minority teachers, tutors, and assistants in open computer environments where they are visible to minority students and can model computer competence. Investigation into the impact of these strategies is ongoing and involves a number of research methods, both quantitative and qualitative.

Method

This research analyzes various aspects of the computer conferencing activity of nearly 12,000 community college students over a two-and-a-half-year period at Glendale Community College, a campus of the Maricopa Community College District. These students contributed to over 250 computer conferences aligned with conventional classroom instruction across the disciplines, including classes in mathematics, science, social science, and humanities, as well as all levels of writing courses. The conferencing system, called the Electronic Forum (EF), supports extensive record-keeping (time in conference, number of entries read, number of entries written, number of words written) and imports demographic information from the Student Information System (gender, ethnicity, age, and current course load). Although the bulk of this research uses data only from course-related discussions, the conferencing program is used heavily by students for both course-related and personal communication. At this campus, where this conferencing program is most fully developed, class discussions represent about 10% of the total on-line activity. During the academic year 1992-93, approximately 5,000 students exchanged 1.2 million pieces of private mail, and during fall semester of 1993, nearly 2400 students spent an average of 2 hours each week reading and writing online.

Research Questions

The volume of writing activity demonstrated by students, and the potential it implies for literacy skills development, has prompted a number of questions about equity: is participation in this program accessible to students equally? That is, do the students who use the Electronic Forum reflect the demographic make-up of the student population as a whole?

Findings

Analysis of data collected from class-based conferences over five semesters reveals that minority enrollment in classes incorporating electronic conferences seems to match or exceed general enrollment demographics of the community college with respect to ethnicity. That is, a pattern of restricted access by minority students to this computer conferencing system does not seem to be emerging. In fact, in four of the five semesters, minority students (Native Americans, Asians, Blacks, and Hispanics) are over-represented among those students who have access to EF as part of their required classwork, although in any given semester, EF users represent only between 12-17% of the student population on campus. Tables 1-5 illustrate the patterns for various groups for each semester; with the exception of Spring, 1992 when there was no significant difference in the access of various groups (p=.1012), during the following four semesters, minority students were significantly over-represented among EF users (p<.0000).

	Observed	Expected	Residual
Native American	21	14.03	6.97
Asian	35	32.23	2.77
Black	40	31.30	8.70
Hispanic	124	114.73	9.27
White, non Hispanic	841	868.71	-27.71

Chi-square=7.7499 D.F.=4 p=.1012

Table 1. College Demographics compared with EF Demographics
(Spring Semester, 1992)

	Observed	Expected	Residual
Native American	29	19.51	9.49
Asian	51	48.36	2.64
Black	74	44.02	29.98
Hispanic	200	162.00	38.00
White, non Hispanic	1028	1108.10	-80.10

Chi-square=39.8719 D.F.=4 p=.0000

Table 2. College Demographics compared with EF Demographics
(Fall Semester, 1992)

	Observed	Expected	Residual
Native American	28	24.20	3.80
Asian	80	54.09	25.91
Black	73	51.11	21.89
Hispanic	247	176.96	70.04
White, non Hispanic	1194	1315.64	-121.64

Chi-square=761.3558 D.F.=4 p=.0000

Table 3. College Demographics compared with EF Demographics
(Spring Semester, 1993)

	Observed	Expected	Residual
Native American	30	21.62	8.38
Asian	57	50.55	6.45
Black	52	40.47	11.53
Hispanic	230	159.05	70.95
White, non Hispanic	1026	1123.31	-97.31

Chi-square=47.4417 D.F.=4 p=.0000

Table 4. College Demographics compared with EF Demographics

(Fall Semester, 1993)

	Observed	Expected	Residual
Native American	31	27.17	3.83
Asian	69	59.91	9.09
Black	114	54.94	59.06
Hispanic	276	189.57	86.43
White, non Hispanic	1150	1308.41	-158.41

Chi-square=123.9853 D.F.=4 p=.0000

Table 5. College Demographics compared with EF Demographics
(Spring Semester, 1994)

Approximately 77% of those students with EF access for their classes actually participate; however, no significant difference in the ethnicity of participants as compared with those merely having access has appeared (p<.0000). Tables 6-10 show the demographic makeup of EF users compared with the demographic makeup of the EF population as a whole for each of the semesters studied. Non-participants are students who neither read nor wrote in the class conference for the entire semester; some of them may have dropped the course.

	Observed	Expected	Residual
Native American	15	16.55	-1.55
Asian	26	27.58	-1.58
Black	29	31.52	-2.52
Hispanic	93	97.70	-4.70
White, non Hispanic	673	662.65	10.35

Chi-square=.8239 D.F.=4 p=.9352

Table 6. EF User Demographics compared with General EF Demographics
(Spring Semester, 1992)

	Observed	Expected	Residual
Native American	21	23.57	-2.57
Asian	38	41.44	-3.44
Black	60	60.13	-.13
Hispanic	153	162.52	-9.52
White, non Hispanic	851	835.34	15.66

Chi-square=1.4163 D.F.=4 p=.8414

Table 7. EF User Demographics compared with General EF Demographics
(Fall Semester, 1992)

	Observed	Expected	Residual
Native American	19	21.13	-2.13
Asian	54	60.37	-6.37
Black	54	55.09	-1.09
Hispanic	181	186.39	-5.39
White, non Hispanic	916	901.02	14.98

Chi-square=1.3132 D.F.=4 p=.8591

Table 8. EF User Demographics compared with General EF Demographics

(Spring Semester, 1993)

	Observed	Expected	Residual
Native American	15	23.72	-8.72
Asian	43	45.07	-2.07
Black	34	41.12	-7.12
Hispanic	181	181.86	-.86
White, non Hispanic	830	811.24	18.76

Chi-square=4.9702 D.F.=4 p=.2904

Table 9. EF User Demographics compared with General EF Demographics
(Fall Semester, 1993)

	Observed	Expected	Residual
Native American	22	22.95	-.95
Asian	42	51.08	-9.08
Black	79	84.39	-5.39
Hispanic	195	204.31	-9.31
White, non Hispanic	876	851.28	24.72

Chi-square=3.1380 D.F.=4 p=.5350

Table 10. EF User Demographics compared with General EF Demographics
(Spring Semester, 1994)

Specific findings with respect to particular ethnic groups may be of interest:

1. Native American students represent about 1.5% of GCC's student population and are consistently over-represented among students with EF access. Their access has increased slightly over the past five semesters. On the average, 33% of the Native American students chose neither to read nor write in their class conferences.

2. Asian students generally represent about 3% of GCC's student population and are slightly over-represented among students with access to EF. Their access has fluctuated over the past five semesters. On the average, 30% of the Asian students chose neither to read nor write in their class conferences.

3. Black students represent slightly less than 3% of GCC's student population and are over-represented among students who have access to EF. Their access has generally increased over the past five semesters. On the average, 27% of Black students chose neither to read nor write in their class conferences.

4. Hispanic students represent nearly 11% of GCC's population and are over-represented among students using EF for classes. Their access has generally increased over the past five semesters. On the average, 25% of Hispanic students chose neither to read nor write in their class conferences.

5. White students generally account for 75-80% of GCC's student population and are generally underrepresented among EF users. Their access has generally increased over the past five semesters. On the average, 21% of White students chose neither to read nor write in their class conferences.

While these figures about access and overall use are encouraging, some statistically significant differences have appeared with respect to the volume of participation of members of different ethnic groups in class conferences. It is becoming clear that members of some groups willingly participate and others write less frequently and at less length. This may represent actual inequities in literacy instruction (Lucas & Schecter, 1992), subtle differences in communication environments (Willis, 1991), or the institution's failure to be proactive in addressing diversity (Trueba, 1993). These differences have not been consistent across semesters nor across groups, and their analysis is made even more difficult because of the occasional presence of some very active writers. In addition, gender may be a contributing factor. For example, preliminary analysis suggests that black women are more comfortable in class conferences (as measured by the amount of writing they do) than black men. However, we can now develop baseline data for extensive longitudinal studies which can identify differences in participation and look for strategies to address them.

Alternative Learning Environments

Several researchers have suggested that in order to address the needs of minority students effectively, educational institutions will have to develop alternatives to the conventional pattern of lecture and large-group discussion (Light, 1990). Emerging data with respect to the participation of minority students in voluntary on-line discussions such as IRC suggests that different kinds of environments, especially ones that seem more "oral," may appear more hospitable to some students, encourage greater participation, and spark an important kind of meta-cognition that students can avoid in other kinds of learning environments (Shedletsky, 1993; Pogrow, 1993). In an attempt to find or create these spaces, DeVaney (1993) suggests that members of minority groups should be able to construct technological environments that reflect their culture and practices.

Many features of computer-mediated computer environments can affect student interest, comfort, and learning, so identifying specific qualities will be quite difficult. In an attempt to discover which groups find which environments more engaging (and following up on some personal observations of computer activity), we analyzed the number of students participating in one such environment, Internet Relay Chat (IRC), for the first fifteen weeks of the Spring, 1994 semester and compared that distribution with the campus population as a whole. Asian students were significantly over represented in this group.

	Observed	Expected	Residual
Native American	12	11.88	.12
Asian	67	26.19	40.81
Black	18	24.02	-6.02
Hispanic	71	82.88	-11.88
White, non Hispanic	549	572.03	-23.03

Chi-square=67.7158 D.F.=4 p=.0000

Table 13. Demographic Analysis of Internet Relay Chat Participants compared with GCC Enrollment
(Spring Semester, 1994)

Compared with the general demographic makeup of EF users, both Asian and White students were over-represented among IRC participants.

	Observed	Expected	Residual
Native American	12	13.55	-1.55
Asian	67	30.17	36.83
Black	18	49.84	-31.84
Hispanic	71	120.67	-49.67
White, non Hispanic	549	502.77	46.23

Chi-square=90.1855 D.F.=4 p=.0000

Table 14. Demographic Analysis of Internet Relay Chat Participants compared with EF User Demographics
(Spring Semester, 1994)

There are a number of reasons why Asian students might find IRC more interesting than other forms of online communication, not the least of which may be their ability to communicate on various channels in their native languages with other Asian students in the United States or around the world. Then again, the interest may be in the synchronicity of communication, the speed and immediacy of response. In addition to surveying students who are active IRC users and analyzing their responses, a strategy possible with computer-mediated communication (Beals, 1992), our next step will be to bring in a number of Internet discussion lists that might be of interest to Asian students, some in languages other than English. By analyzing student participation in asynchronous discussions, we may be able to determine whether the attraction is cultural or structural.

Providing Role Models

Students' sense of their own computing competence is affected not only by their own ability to perform adequately, but also by their observations of others similar to themselves who are also successful (Olivier & Shapiro, 1993). Role models for minority students are critical (Resta, 1992); that means that not only must there be adequate numbers of minority group members who can model computer competence, but they must also be visible, interacting with students on a regular basis. The over-representation of minority students among EF users is encouraging in this respect.

Architecture and staffing policies can make a difference in the "visibility" of role models. Glendale has two large, open computing facilities which make use of student workers who have demonstrated computing expertise. More so even than faculty members, these individuals work closely with students, providing motivation and assistance, modeling computer competence. The demographic makeup of this group during Spring, 1994, reflects the diversity of the campus with respect to ethnicity except for participation of Native Americans. The difference with respect to gender between Instructional Associates and college enrollment is non-significant, although women are under-represented.

	Observed	Expected	Residual
Native American	0		
Asian	4	3.12	.88
Black	3	2.86	.14
Hispanic	13	9.87	3.13
White, non Hispanic	64	68.15	-4.15

Chi-square=1.4972 D.F.=3 p=.6829

[Chi-square statistic questionable because 2 cells have expected frequencies of less than 5; minimum cell expected frequency is 2.9]

	Observed	Expected	Residual
Male IAs	45	38.39	6.61
Female IAs	40	46.61	-6.61

Chi-square=2.0735 D.F.=1 p=.1499

Table 15. Demographic Analysis of Instructional Associates as compared with College Enrollment
(Spring Semester, 1994)

Recommendations

In many cases, providing technological environments that foster increased access to learning for members of minority groups can be accomplished at little or no cost (Martin & Hearne, 1989). Obviously, it is a useful barometer of access to continue to collect data each semester with respect to the participation of minority group members in discussions aligned with their classes and in the diversity of the group of Instructional Associates hired to help those students. Cross-district analysis (and cross-institutional analysis as well) may help us identify policies, climates, and strategies that are effective (or not, as the case may be). In addition, the following initiatives can be launched at little or no cost:

- Increase the variety of courses (and the range of instructional levels) that employ computer-mediated communication as an instructional tool;
- Identify (by textual analysis of class discussions and surveys) issues of interest and importance to minority students;
- Sensitize teachers to different kinds of communication practices common among different ethnic groups and show how they are revealed in online communication;
- Work with campus clubs and groups as "sites" of peer-based learning;
- Develop connections with the feeder high schools to introduce college-bound minority students to a variety of open computing environments;
- Enlist members of minority groups to "scour" the Internet for additional resources of particular interest;
- Encourage teachers and students to collaborate on creating unconventional learning environments.

Enhancing minority students' facility with technology, especially in ways that recognize and respect ethnic differences, may have immediate and long-range effects on students' persistence, academic success and career satisfaction.

Works Cited

Badagliacco, J. M. (1990). Gender and race differences in computing attitudes and experience. Social Science Computer Review, 8(1), 42-63.

Attitudes toward computing differ according to race, ethnicity, and gender. Men have more positive attitudes, and women less positive. Whites have more experience with computers, and Hispanics have less experience. These differences have serious implications for higher education because, if women and racial and ethnic minorities self-select themselves out of courses employing technology, they may be committing themselves to membership in an "underclass" which limits their opportunities for economic success.

Beals, D. E. (1992). Computer networks as a new data base. Journal of Educational Computing Research, 8(3), 327-345.

Computer-mediated communication, because messages can be collected and stored for later analysis, can help researchers identify patterns of communication and reveal how people think, how they respond to different kinds of situations, what roles they bring to networked communication and how those roles can change.

DeVaney, A. (1993). Reading educational computer programs. R. Muffoletto, & N. N. Knupfer (eds.), Computers in education: social, political & historical perspectives, (pp. 181-206). Cresskill, NJ: Hampton Press.

Analyzing common computer software reveals their sexist and racist underpinnings, primarily because they make use of popular culture, itself racist and sexist. It is critical that educational software treat its users with respect, provide various people as its subjects, and promote authenticity rather than stereotypes. This is possible to achieve by putting technology under the control of groups usually disempowered by it and encouraging them to pursue equity and personal freedom. It is important to encourage ethnic groups to construct technological spaces that reflect their culture, and to allow women to create programs that foster cooperation.

Light, R. J. (1990). Harvard assessment seminars: Explorations with students and faculty about teaching, learning, and student life. (First report),Cambridge, MA: Harvard University.

Support groups that study together are critical for learning, especially for women. More involvement with out-of-class activities is correlated with higher satisfaction with college. Language facility is critical for academic success; lack of language skills is a barrier to academic progress.

Lucas, T., & Schecter, S. R. (1992). Literacy education and diversity: Toward equity in the teaching of reading and writing. Urban Review, 24(2), 85-104.

Literacy instruction for minority students is affected by the characteristics of the individual students, by sociocultural elements, by language differences and by instructional culture. It is the responsibility of schools to redress language instruction inequities.

Martin, B., & Hearne, J. D. (1989). Computer equity in education. Educational Technology, 29(11), 47-51.

Minority group members, women, and disabled persons frequently lack computer experience; this hurts their career development and helps to reinforce the stereotypical notion that they have less computer aptitude. Cultural and economic forces help perpetuate this differential development of computer experience, but most of the variation in computer access for different groups can be redressed by administrative leadership and personnel commitment. Enhanced consciousness can change these patterns.

Neuman, D. (1992). Technology and equity. D. P. Ely, & B. B. Minor (editor), Educational Media and Technology Yearbook Vol. 18, (pp. 100-103). Englewood, CO: Libraries Unlimited.

Using technology does not automatically promote equity. The ratio of students to computers is highest in wealthiest districts and lowest in the poorer districts. In addition, it is common for students at the lowest levels to be relegated to using the least imaginative software. In some schools, computers are located in areas to which only the most advanced students have access. Finally, much educational software makes use of sounds, graphics, and plots that reinforce "masculine" traits and thus encourage girls in their negative attitudes.

Olivier, T. A., & Shapiro, F. (1993). Self-efficacy and computers. Journal of Computer-based Instruction, 20(3), 81-85.

Self-efficacy, the perception of one's ability to perform specific tasks, is a judgment derived from success in one's efforts, observations of others' succeeding, encouragement from others, and anxiety. Behavior modeling, because it enhances one's sense of self-efficacy, is a more effective teaching strategy than use of computer tutorials. Self-efficacy with respect to computers is directly correlated with mathematics confidence and perceived mathematics ability. Various assessment instruments exist to measure self-efficacy, and their use could point to opportunities for strategic interventions and instructional improvement.

Padilla, R. V. (1992). Using dialogic research methods to study Chicano college students. Urban Review, 24(3), 175-183.

Dialogic research methods, Freire's "psycho-social method," can help researchers discover "generative themes" embedded in a particular group of students. This research identified three themes: a sense of social isolation from family, a recognition of the personal cost of academic achievement, and a feeling of ambiguity about ethnic identity. These themes were worked out in both inter-ethnic and intra-ethnic struggles. Identification of these conflicts can point to intervention strategies that will help Hispanic students persist in their education.

Pogrow, S. (1993). A learning drama approach to using computers with at-risk students. R. Muffoletto, & N. N. Knupfer (eds.), Computers in education: social, political & historical perspectives, (pp. 207-217). Cresskill, NJ: Hampton Press.

At-risk students (beyond the third grade) do not benefit from, and may actually be harmed by the use of explicit-goal software (conventional CAI as well as word-processing programs and simulations). Such software assumes that at-risk students fail to learn because they do not practice working with concepts, but current research shows that the problem is more a failure to recognize and apply mental strategies to problems. That is, at-risk students do not know what it means to understand; they do not know how and in what situations to generalize, hypothesize, or predict. Better software provides intriguing problem-solving settings that spawn conversations about what is happening, encouraging students to develop critical thinking skills.

Resta, P. (1992). Organizing education for minorities: enhancing minority access and use of the new information technologies in higher education. Education & Computing, 8, 119-127.

Minority students, who generally enter college with less background and experience with computing, do not have equal access to tools which help majority students achieve academically, and thus can remain "information-disadvantaged." Providing special computing programs directed toward minority students, encouraging minority students to develop their computer skills, recruiting minority students as workers in computing labs, and building cohesive minority groups through electronic networks are strategies that institutions of higher education can use to redress these imbalances.

Ross, S. M., Smith, L., Morrison, G., & Erickson, A. (1989). An apple a day and at night: A distance tutoring program for at-risk students. Educational Technology, 29(8), 23-28.

Distance tutoring, in which at-risk students have increased opportunities to interact individually with teachers, can make use of the increased educational benefits of personalized instruction and mitigate the logistical problems of time and expense. This project had beneficial effects on student writing.

Shedletsky, L. (1993). Minding computer-mediated communication: CMC as experiential learning. Educational Technology, 33(12), 5-10.

Computer-mediated communication can promote four different kinds of learning: response learning (negotiating commands and keystrokes), situation learning (developing ideas about the meaning and usefulness of CMC), transsituation learning (reflecting on changes in one's interpretation of the CMC experience), and transcendent learning (inventing new ways of thinking about CMC).

Trueba, H. T. (1993). Race and ethnicity: The role of universities in healing multicultural America. Educational Theory, 43(1), 41-54.

Educational institutions can heal bitter social, political, and economic divisions between different ethnic groups by promoting a "multicultural literacy" in which cultural differences are acknowledged and where new means of communication across them are practiced. Schools are not neutral institutions; they are political environments in which a social order (usually the current one) is perpetuated. Given the current crisis, schools must become more active in addressing issues of educational inequity presented by the increasing proportion of immigrants, refugees and minorities in society.

Willis, J. (1991). Computer mediated communication systems and intellectual teamwork: Social psychological issues in design and implementation. Educational Technology, 31(4), 10-20.

Researchers usually identify either engineering and technical reasons or business and marketing reasons for the success or failure of technological innovations; however, the social and behavioral sciences can also provide analytic frameworks. Electronic communication can provide access to information (either "standard" or "specialized"), can enable participants to exchange information, or can enable collaboration (either to solve problems or to develop and exchange information). These different uses may require tailored communication systems.

Yellin, D., & Koetting, J. R. (1988). Literacy instruction and children raised in poverty: A theoretical discussion. Journal of Curriculum Theorizing, 8, 101-114.

In order to improve the educational success of disadvantaged students, schools must employ a new form of literacy instruction that focuses on literacy as a means for the communication of ideas. The history of both reading and writing instruction has followed a circular route: beginning with instruction in isolated skills, moving to embedded instruction, and then back to emphasis on teaching discrete or so-called "basic" skills. Current educational practice with its emphasis on pretest-posttest cycle, standardized curriculum, specified outcomes, and measurable objectives has served to reinforce this reductive, "techno-rational" picture of literacy. An alternative model promotes "real reading and writing" of texts that have personal importance to students' lives.

Title:

Applying an Interactive Evaluation Model to Interactive Television

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Abstract

The effectiveness of an evaluation model for interactive television courses was studied. Inquiry was conducted with distance education graduate students to obtain their authentic voices about a traditional model: Small Group Instructional Diagnosis (SGID), a facilitator-based model. Analysis of students' on-line comments and administrative actions indicated that SGID is effective for these students. Student interaction between the process and facilitator were cited as important in the helpfulness of the process. Items on hindering student interactions with the process were identified by more remote site students than by those on campus. On-site students were more apt to indicate no interactions hindered the process and that no changes were needed. Administrators demonstrated change activity. These results are consistent with the data on SGID and have potential for those evaluating graduate courses delivered by two-way audio and video.

Applying an Interactive Evaluation Model to Interactive Television

Introduction

The use and the effectiveness of student evaluations concerning course offerings and instructor effectiveness have been documented in both distance education and traditional classroom settings. Numerous studies of distance education incorporate student evaluations as one or more of the tools used to assess course effectiveness (Dillon, Gunawardena, & Parker, 1992; Schlosser & Anderson, 1994; Wagner, 1993). Maitino's review of current research on student evaluation of college instruction in traditional classrooms (1992) supports the reliability and relevancy of such data.

In 1979, Clark and Bekey refined a University of Massachusetts clinical model that provides mid-semester evaluative feedback to the instructor based on oral information given by small student groups to an external, trained facilitator who spends one class period alone with the students. During the period, after separating the students into small groups, the facilitator directs all the students in each group to provide answers to two questions about everything that helps and hinders their learning in the course. A third question is also posed that asks for their input on any needed changes. After a recorder from each group provides all the responses, the facilitator leads the class in clarifying the responses to assure mutual agreement on meanings. The class then votes on each response, indicating the degree to which each student supports each item. After the class session, the facilitator meets with the instructor, providing the ranked results of the student responses, interpretative comments, and suggestions for improving instruction.

This process, the Small Group Instructional Diagnosis (SGID), that has appeared in the literature on teaching effectiveness as one type of evaluation technique, has been shown to open the lines of communication between faculty and students and (Seldin, 1988).

Recently there has been an increased interest in conducting research that encourages the application of research methods that produce results leading to immediate change and supporting improved practice in teaching. While there is debate over the distinction between practical classroom inquiry and "teacher as formal educational researcher" (Richardson, 1994, p. 7), a distinguishing feature of the latter is applicability of results to a broader community. Such qualitative studies have the potential of providing researchers with opportunities for describing natural habitats as they are with minimal disturbance; providing insights to existing themes and addressing immediate needs.

No one source of data is sufficient for evaluating the efficacy of an instructional situation (Seldin, 1988). While a concern facing those engaged in qualitative studies is structuring and validating the resulting data, triangulation is an approach that lends support to the analysis. Through comparisons of interview data with observational data and anecdotal reports, and by investigating participants' comments and behaviors, patterns can often be seen to emerge that support hypotheses, or lead to revised insights (Patton, 1987). This study, while based primarily on data gathered from student reports on their perceptions of the effectiveness of a formalized evaluation process, also provides data from actions of the stakeholders: program administrators, faculty members and Department of Education teachers.

A structured, open-ended questioning format familiar to the distance education students was selected to provide a vehicle in which their authentic, diverse voices could be heard as they provided their perceptions of learning in two distance education courses.

In the body of work on distance education, the emphasis on evaluating the impact of distance education courses can be categorized as:

- Comprehensive: The overall approach and design of evaluation of distance education (Thorpe, 1988; Zvacek, 1994).
- Administrative: The uses of distance education (Dillon, Gunawardena, & Parker, 1992) and its costs (Willey, 1991; Zvacek, 1994).
- Instructional Design: The study of student learning in terms of suitability of courses (Willey, 1991) and student perceptions of interaction (Fulford & Zhang, 1994).
- Learner Achievement and Attitude: The factors contributing to student success and positive attitudes in distance education situations (Dillon, Gunawardena, & Parker, 1992; Lauzon, 1992; Schlosser & Anderson 1994; Verduin & Clark, 1992; Walker & Hackman 1992; Willis, 1991).
- Technical: The effectiveness of distance education courses in terms of delivery systems (Egan, Welch, Page & Sebastian, 1992; Schlosser & Anderson, 1994).

Among the emerging trends in distance education (Birenbaum, Glick, & Kinsler, 1994), is the continued emphasis on examining the effects of distance education on the learner. This study used such a focus— with the focus on learners who were involved in a new cooperative distance education university and school department partnership. By employing a broadly structured, open-ended format for obtaining data from the learners, this study allowed student input in any of the areas for evaluating distance education: comprehensive, administrative, instructional design, learner achievement and attitude, and technical. Given the structure of the inquiry, one anticipated outcome was that the resulting data would have an emphasis on learner related issues, a result which was supported. Similar to studies by others in the field of distance education research (Holmberg & Bakshi, 1992; Walker & Hackman, 1992; Kember, Lai, Murphy, Siaw, & Yuen, 1992), this study relied on a survey for gathering information from the participants.

At the University of Hawaii, Small Group Instructional Diagnosis has been employed for the past five years by its Center for Teaching Excellence, a unit within the Office for Faculty Development and Support. At the mid point of the semester in traditional, intact classes throughout the campus, trained faculty and teaching assistants from the Center assist faculty in assessing the effectiveness of their courses by obtaining student perceptions about their learning. In addition, since 1969, when the University of Hawaii offered the first college credit course delivered by satellite, the university has been developing its interactive television facilities. The Hawaii Interactive Television System (HITS) currently delivers a wide range of courses at the undergraduate and graduate levels using a technologically advanced delivery system that incorporates two-way audio and video at its origination site on the island of Oahu and at its receive sites on the neighbor islands of Kauai, Hawaii, and Maui. To date, evaluation of HITS courses and programs has been accomplished through written responses provided by both students and HITS instructors in end-of-semester questionnaires. None have incorporated the unique interactive feature offered by HITS into the evaluation process.

With the SGID model and HITS at the University of Hawaii, the resources were available for undertaking a preliminary investigation of the effectiveness of applying an interactive classroom evaluation procedure, SGID, to introductory courses in a cluster of five Department of Educational Technology (ETEC) graduate courses, entitled Telecommunications and Technology for Teachers (T^3), delivered via interactive television. Although the SGID model has been used in traditional class settings, it had not been used in a distance education class at the University of Hawaii and no instances of its use in other distance education classes were discovered.

The department faculty determined to apply the SGID at mid-semester to the T^3 program to obtain timely feedback on the program and to assess the effectiveness of this evaluation technique in a distance education setting.

Questions under investigation were:

Question 1: Would a modification of the SGID, delivered as a computer-mediated communication, provide data of sufficient quality and quantity for use in a study of SGID as a distance education evaluation process?

Question 2: Would a cohort of graduate students enrolled in a cluster of distance education courses differ in their perceptions of a course evaluation process, the Small Group Interactive Diagnosis? Would those perceptions be influenced by receive site location; by effects of two-way audio and video during group reports to the entire class; by the effects of video graphics used for ranking results of small groups reports; and by the large group sizes that some sites may have during the SGID?

Question 3: Would the results of the process be available for program administrators and instructors in a timely manner, allowing for program and course revisions?

Methods and Procedures

Subjects

The population for this study consisted of a cohort of fifty Department of Education teachers and specialists enrolled in the first two of five graduate level, courses that comprised the Telecommunications and Technology for Teachers (T^3) Program. The T^3 courses were scheduled two nights per week for the fall and spring semesters of 1993-1994, with the final course scheduled in the first 1994 summer session. While these courses were part of the graduate program offered within the Department of Educational Technology at the University of Hawaii, they did not of themselves comprise an official program of study. The Department of Education acknowledged the completion of the five courses with a T^3 Certificate of Completion, which led to the informal designation of the courses as the T^3 Program.

Students were located at three remote sites: the islands of Maui, Kauai, and Hawaii. T^3 students were also present at the main campus transmission site on the island of Oahu. Ninety percent of the cohort, 45 students: 21 from the on-campus site and 24 from the remote sites, participated in the Small Group Instructional Diagnosis during the ninth week of the 15 meeting cycle. Following the SGID protocol, a trained, external facilitator met with the students for an entire class period without the presence of the instructors. The students actively analyzed the effectiveness of the first two courses in the T^3 Program by responding to three questions about what helped their learning in the program, what hindered their learning in the program, and what changes they would suggest for the program.

At the conclusion of the two courses, the participants were asked to evaluate this SGID process using a version of SGID modified for delivery as a computer-mediated communication.

Eighty-seven percent of the 45 mid-semester participants participated in this evaluation: 19 from the on-campus site and 20 from the remote campuses. These 39 students formed the sample for this study. Characteristics that the sample have in common with all distant education populations are their adult status and the predominance of females, 82%. Their wide ranging ethnic backgrounds, while typical for the state of Hawaii, are not typical of other distance education students. This study is limited by its intact population.

Measures

Computer Mediated Communication SGID: The quantity and quality of responses to the on-line delivered survey questions were assessed by amount and quality of information conveyed. A response rate indicative of 75% was established as a way to assess the quantity of the returns (Seldin, 1988). Response quality was assessed by the degree to which the respondents provided usable information for each of the three questions.

Perceptions of the SGID: To assess the extent to which the subjects differed in their perceptions of SGID, a modified version of the SGID process itself was used. As a qualitative measure, it has no reliability coefficients; its construct validity is attested to by use by others since 1979 (Clark & Bekey, 1979; Seldin, 1988; Theall & Franklin, 1990). The overall impact of the SGID was assessed through a comparison of the number of responses for each of the three questions in relation to positive responses.

The three questions designed to elicit open-ended responses about the positive and negative aspects of the evaluation process, as well as to elicit suggestions for changes in SGID, were sent to the on-line T^3 discussion list. The request and survey were transmitted to the T^3 students on the discussion list that had been established and extensively used throughout both courses. To participate in the study, the students had to have participated in the SGID administered at mid- semester. Responses were sent to the primary researcher. Attesting to their interest in evaluating the process, in addition to responding to the researcher, over 40% of the respondents elected to send a copy of their responses to the T^3 discussion list, following the T^3 program protocol of sharing information of general interest with all participants.

Patterns of concepts and frequency of words and phrases related to the variables of site, effect of delivery mode/graphic display, and group size were set as the way to interpret responses related to those variables.

Program Impact: To study the impact of the results of the SGID on the T^3 Program, the log of administrative actions occurring after reception of the SGID results was analyzed by types of actions.

Data Analysis

Question 1: To assess the viability of using the on-line generated responses, the response rate was computed for both inter group and total group and compared to the minimal desired rate of 75% (Seldin, 1988).

Question 2: To assess differences in the perceptions of the distance education students at both the on-campus and remote sites, student responses relevant to the three SGID questions were carefully reviewed, separated into discrete phrases, coded, and entered into a database and analyzed.

During the preliminary analysis of the phrases, a conceptual framework emerged that appeared related to the three interactions identified by Moore (1989) regarding distance education settings. His "learner-content interaction" emerged as "learner-format interaction" for this analysis. Participants' responses, such as, "The three questions were to the point," were placed in this category. Moore's "learner-instructor interaction" emerged as "learner-facilitator interaction" with the facilitator referring to the person who conducted the SGID. Statements, such as, "having a patient and objective facilitator," were identified as learner-facilitator interactions. No changes in the semantics for Moore's "learner-learner interaction" category were deemed necessary. Statements, such as, "being able to see the number of students that agreed with my feelings," were identified as learner-learner interactions.

The plausibility of this coding was tested with an expert panel, consisting of the researchers and an external evaluator. The researchers provided deep understandings from their immersion in the setting; the independent expert provided an unbiased view and knowledge as an evaluation specialist. Response categorizations, made independently by the expert panelists for all items, revealed a high degree of inter-rater agreement with the fit of Moore's modified typology. Those items not agreed upon were discussed, resulting in mutual agreement on the categorization of all items.

Further analysis within the typology was carried out with like words and phrases within the database. For example, "continue" and "don't change" were considered synonymous.

Question 3: To analyze program activity generated by the results of the SGID, related occurrences were analyzed by investigating the data arrayed on a timeline.

Results

Question 1: The results revealed a response rate of 87% for all sites, with an on-campus site response rate of 90% and a remote site response rate of 83%. All response rates exceeded the standard set for a minimal 75% return rate, thus, providing sufficient quantity of data for analysis. As indicated in Table 1, the data was relevant to the three SGID questions. Of the 213 types of responses, only 6 items were not applicable to the three questions: "What helped the evaluation process?" "What made the evaluation process difficult?" "What recommendations do you have for changes for the mid-semester Small Group Instructional Diagnostic process?" Both the overall high return rate, 87%, and the number of usable items, 207 out of 213, indicated that the computer mediated communication was an effective process for gathering data for this study from participants who were all active in their use of on-line communications. These participants were characterized as having a high level of comfort in sending messages and to each other, to their instructors, and to the T^3 discussion list. The response rate may not be replicable for new on-line users or for users who are not used to corresponding with their instructor in this manner.

Question 2: To determine any differences between the on-campus and remote site participants, within group percentages for responses were calculated and compared. As indicated in Figure 1, few differences were reflected by respondents. Approximately 50% of the comments referred to the helpfulness of the evaluation process, regardless of the location of the respondent. Less than 26% referred to hindrances, or need for modifications, for SGID. An examination of Table 1 reveals that some differences do appear within sub categories of the three main categories, with the most marked differences appearing in relation to hindering interactions. At the remote sites, 74% of the responses given by the participants, such as, "Towards the end of the session, we felt pressed for time," were categorized as being learner-process interactions, in comparison to only 50% of this type of comment being given by participants at the on-campus site.

A new type of sub category emerged; one reflecting, "no problems". While actual numbers are small for meaningful interpretations of this subcategory, it is interesting to see the patterns that appeared within both the hindering interactions and changing interactions categories. At the on-campus site, a total of eight comments, such as, "I don't think that there was anything that made the process difficult," in the hindrances group and eight, such as, "I would recommend we continue to have mid-semester diagnostic feedback sessions," in the modifications group were made. In both instances, however, only two or less were made at a remote site. The remote site also offered 18% more comments on ideas for changes related to learner-process interactions than did the on-campus group. These comments included, "Perhaps a faster way of counting the 'votes' for each of the items. Maybe using the fax machine to facilitate this." "Also, perhaps limiting each group to 3-5 answers to each question. I think this would eliminate some answers that were repetitive and some that were 'off the wall' and subsequently received few votes."

After categorization of items by the panel into types of interactions, like items were further collapsed to create items of similar concepts, so that "professional manner", "professionally done", "excellent job", and , "leadership skills" were categorized as overall skills of the facilitator. These items were ranked by sites based on frequency counts within groups. The results of this ranking, displayed in Tables 2 through 4, show, that regarding helpful interactions, strong agreement was reflected at all sites regarding the excellent overall skills of the SGID facilitator. This item was mentioned more than any other for all groups, as well as by the remote site group. For the on-campus group, this item was in a three-way tie for first place with "the facilitator's ability to create a supportive atmosphere" and in the learner-learner interaction subcategory, with "professionalism of the group". Tables 2 through 4 provide a comparison of items that respondents cited most frequently. Unanimity was reached across groups on hindering interactions within the learner-process interaction subcategory with "the amount of time for the process" being the most frequently mentioned item being perceived as a problem and, similarly, in the change interactions category with "conducting earlier in the semester".

An analysis of the number of times that specific references to any constraints imposed on the evaluation process by the effects of two-way audio and video on the group reports and of the video graphics used to display the group reports for voting, showed that these items received specific mention only once each at the remote sites and no mention at the on-campus site. The remote site comments were: "It was difficult not being in the same room because comments were made that [were] not stated openly." "TV made it difficult to keep track of all the comments since all of the writing had to occur on the elmo [visual presenter]. Still this is a limitation that cannot be helped." One positive comment was received from a remote site in regard to the visualization of the group's ideas: "I also think it helped that [the facilitator] wrote down all the ideas and paraphrased to ensure agreement."

There were more items related to the large group sizes with five comments, 6.8%, from the on-campus site regarding learner-learner interaction problems: "I did notice some people did not volunteer much for discussion. It was their choice though." The remote sites offered three negative comments, 5.3%, in this regard. A typical comment was, "The group was a little too large." At the same time, both the on-campus and remote site participants made ten comments, 13.5% and 17.5% respectively, regarding the helpfulness of the learner-learner interactions: "I liked how it was directed and that we were broken up into groups so our 'voices' could be heard collectively". "Group memory kept the group focused on the tasks." These results indicate, that for these participants, the issue of technical issues and group size were not predominant concerns.

Question 3: To analyze the data in relation to question 3, to see if the results from the Small Group Instructional Diagnosis provided results in a timely manner to allow for program and course revisions, the activities that the process engendered were plotted on a timeline. Figure 2 shows the increase in activity immediately prior to the administration of the SGID, and the subsequent activity following the process. Of particular note is the appearance of the Task Force on the Technology Specialist. This Task Force, charged with the examination of the actual role of the proposed new Department of Education (DOE) specialization, had been discussed at prior meetings, but the SGID provided the impetus to bring stakeholders from both the ETEC Department and the DOE together to identify the skills needed by someone in this proposed position. The ETEC Department also used the results of the SGID for long-range and short-range planning. Based on SGID data on course scheduling, courses for the following semester were scheduled in tandem rather than concurrently. For the long term, the ETEC Department began re-examining the courses selected for the program in light of the new scheduling, with plans for a seminar session to be interwoven throughout the courses.

Discussion

In this study, a model for evaluating two distance education courses that formed part of a program of study, was investigated. The range of data obtained from the distance education participants supported the recommendation from a study of seven distance education courses in Hong Kong (Kember et al., 1992) that others include more than one course in their evaluation to provide a broader range of input. Although the

Kember et al. study used a mix of qualitative and quantitative methods, their qualitative data was used more extensively in their analysis.

Time constraints posed limits on the manner in which this computer mediated communication version of the SGID, used for gathering data on the actual SGID, was executed. The facilitator role of restating and clarifying items which could have been attempted on the class discussion list, was omitted in the on-line version because of the time constraints imposed by the approaching end of the semester.

This study provided a connection to the everyday world of educational practice. The high response rate to the on-line SGID, in less than three weeks by the Distance Education students, reflected the appeal of this modified version for data gathering, supporting Reinharz's endorsement for using "special techniques that are "unobtrusive measures" (1993). His support for having good pre-conditions for a specific method was supported by the familiarity and positive attitudes of the participants, toward on-line communication. Lauzon (1992) also supports on-line communication as an excellent medium for meaningful interactions between learners and facilitators, instructors, and each other. A version of SGID modified for use as a computer mediated communication did provide useful information for this qualitative study.

Analysis of the comments was carried out by the expert panelists, using the students' language to tell what was considered important, requiring reliance "on their own intelligence, experience and judgments" (Patton, 1987, p. 154). The use of Moore's typology (1989) that emerged from the analysis of the authentic voices of the participants, gave structure to the analysis of the items and, thus, guidance for replicating this study.

Identifying a modification of Moore's typology, instead of creating their own, also gave the authors a way of portraying the students' views in a manner that addressed, to some degree, the potential for bias that could arise for the authors in their dual roles as participants throughout the SGID process and as authors of the study. The external member of the codifying panel attested to the validity of applying the adapted version of Moore's typology.

The emergence of three categories of the interactions of learner-format ("learner-content" in Moore's categorization), learner-facilitator ("learner-instructor" according to Moore) and learner-learner supports the distinctions being made in the field of distance education of the importance of identifying typologies for interactions. Such schemata lead to improved communication and study within the field (Moore, 1989). It is of note that two types of responses did not fit his typology; these responses are the items that were cited when participants were asked to name hindrances or changes to interactions. The responses of "no hindrances" and "no changes" were noted in separate categories established to accommodate this type of response.

The data from this study suggests use of the Small Group Instructional Diagnosis as an effective evaluation model for distance education students enrolled as a cohort in graduate level education courses. More than 50% of the response items related to factors that helped the process, regardless of the site; with only 21% of the items at the remote sites and 16% of the items at the on-campus site related to items that interfered with the process. This finding supports an earlier evaluation (Clark & Bekey, 1979) of the process. In Clark & Bekey's evaluation of the effectiveness of SGID for students in a traditional educational setting, 80% of the participants stated that SGID was useful when asked to respond in either the affirmative or the negative.

While a little less than 7% of the distance education, campus-based students registered their enthusiasm for the SGID in statements on "continuing/not changing the process" and in requests "for using the process" in their roles as teachers, no similar remarks were noted from the remote site students. The remote site participants made quantifiably more hindering interaction statements than the on-campus participants, although both types of participants identified "the amount of time for the process", "time limits", and "peer pressure" as their top concerns. The remote site participants expressed a greater range of comments, from statements such as "the voting didn't quite express the ideas", "negative feelings", and "versions varied by site". This wider range could be indicative of differences that may have occurred from aggregating the responses from three different remote sites into the sole category of "remote site" and from two of the remote sites having less options for forming varied groups than the on-campus site and the third remote site, both of which could accommodate three groups of seven .

The size of the groups, most of which consisted of seven participants, and as such violated by one person the maximum number recommended for groups in the SGID (Clark & Bekey, 1979), may account for the concerns expressed about time. The additional person may impact the amount of time available for optimal learner to learner interactions.

Although reports of SGID may omit mention of, or not stress, administration by a trained facilitator (Theall & Franklin, 1990; Seldin, 1988), the presence of a trained, external facilitator was the factor students in this study most strongly supported; a factor also identified as critical in the work of Clark and Bekey (1979). Having the opportunity to express ideas; anonymity; satisfaction in knowing the results would be listened to by the stakeholders in the program; and having clear guidance for the process were themes that appeared in comments in both this study and in Clark and Bekey's work. In regard to the closely related topic of interaction between learner and instructor, Dillon, Gunawardena, & Parker (1992) found that such interactions, during class time, were viewed as the most important form of interaction with the distance education students they studied.

Although Clark and Bekey's procedure for administering the SGID requires that the facilitator's visit not be announced in advance to avoid student absences by some who might feel strongly about the class, unlike Clark and Bekey's process, SGID at the University of Hawaii, provides prior notice. This study followed that pattern, with no change noted in the attendance patterns. The participants in this study provided further support for the idea of prior notice, by recommending that the three questions be distributed prior to the process.

Students offered few comments on the audio and video delivery system, despite Walker & Hackman's finding (1992) that clear audio and video were significant factors for distance education students. Given the ease and technical sophistication with which the HITS delivery system functions at the University of Hawaii, this finding was not unexpected for these students.

Following guidelines for using evaluations for improving instruction (Maitino, 1992; Theall & Franklin, 1990), the direct effects of the SGID results were the inter and intra university and school departmental meetings to hear the results of the SGID and to plan for recommended changes. While many factors figured in the advancement of tentative plans for developing a technology specialist certificate within the Department of Education and the concomitant graduate level training, an examination of the timeline in Figure 2 shows the close proximity of the major thrust of that work to the SGID. The university and school stakeholders focused formally on a Task Force charged with identifying needs and defining the role for such a professional after receiving the results of the evaluation process.

Implications

While some studies show linkages of student achievement to students' ratings of courses (Cohen, 1981), others (Byrne, 1992) question the validity of using such data, because of the dangers inherent in obtaining reliable estimates of coefficients from small samples, particularly if employment decisions for instructors are based on such results. Given the small number of participants and lack of legal access to student grades, this study made no attempt to examine the relationship between the students' ratings and their academic achievement in the courses. Future researchers with larger samples may wish examine such quantitative data in relation to the qualitative data the SGID provides. The results of this study should be interpreted with caution as a descriptive study of informal linkages.

Others may wish to draw upon the ease with which the methods employed in this study obtained cooperation from the participants and with the ability to gather a wide range of perspectives.

The pattern that emerged from this research is the critical role the facilitator plays in SGID. Future studies need to further investigate the significance of this effect.

In light of the recognized importance of perceived interactivity to distance education student satisfaction (Fulford & Zhang, 1994), future studies may also wish to investigate the relation of SGID in contributing to student perceptions of interactivity within their distance education environment.

The SGID provides a structure that meets guidelines for obtaining student ratings for improvement. Seldin (1988) has defined these guidelines as: asking diagnostic questions; having open-ended response format support feedback on an infinite variety of factors; maintaining confidentiality for instructors; providing questions that students are capable of answering; encouraging instructors to actively participate by adding any specific questions they may have; being able to use other evaluation instruments; supporting comprehensive student involvement; and providing written comments. SGID accommodates all these guidelines.

The assessment of student attitudes toward their distance education milieu is one of the factors that continues to appear in the literature on distance education (Thorpe, 1988; Wagner, 1993). This study attempted to link research and evaluation of distance education in the area of student learning in relation to graduate level in-service teachers located on four islands in Hawaii.

Given the factor that college courses delivered by television reach more adult students at more colleges than any other type of technology-based course (Brock 1991), there is a need to continue investigating evaluation methods for such distance education courses. To fill the continuing need for rigorous practical research on assessment for distance education (Holmberg, 1991), future studies with diverse distance education populations could be designed to employ Small Group Instructional Diagnosis, which, with its potential for gaining broad insights into students perceptions and attitudes about distance education courses, in combination with quantitative measures, has the potential for providing additional insights into student satisfaction in distance education settings.

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This study was conducted to obtain information on the effect of the Small Group Instructional Diagnosis for use not only within the college and within the university's Center for Teaching Excellence, but to encourage others to investigate its effectiveness in studies on improving learning.

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Table 1

Typology of Student Reactions to Small Group Instructional Diagnosis Model by Sites

Types of Interaction in Evaluation Process	Sites					
	All		Campus		Remote	
Helpful Interactions						
Learner-Process	44	(41.0)	23	(44.2)	21	(37.5)
Learner-Facilitator	44	(41.0)	19	(36.5)	25	(44.6)
Learner-Learner	20	(18.5)	10	(19.2)	10	(17.2)
Hindering Interactions						
Learner-Process	28	(62.2)	11	(50.0)	17	(74.0)
Learner-Facilitator	1	(2.2)	0	(0.0)	1	(4.3)
Learner-Learner	8	(17.7)	5	(22.7)	3	(13.0)
None	8	(17.7)	6	(27.3)	2	(8.7)
Change Interactions						
Learner-Process	46	(85.2)	24	(77.4)	22	(95.7)
Learner-Facilitator	0	(0.0)	0	(0.0)	0	(0.0)
Learner-Learner	0	(0.0)	0	(0.0)	0	(0.0)
No Changes	8	(14.8)	7	(22.6)	1	(4.3)

Note. n is based on number of items, not respondents. n = 207 for all items. n = 105 for on-campus items. n = 102 for remote campus items. Percentages figured on 100% for the three main types of interaction appear in parentheses.

Table 2

Ranking of Student Comments Concerning Distance Education Evaluation Model Related to Types of Interaction by Site: Helpful Interactions

Types of Interaction in Evaluation Process	Rank by Sites All	Rank by Sites Campus	Rank by Sites Remote
Helpful Interactions			
Learner-Process			
Structured questions	1	2	1
Opportunity to express ideas	2	1	–
A third party guide	–	–	2
Non-threatening environment	–	–	2
Meaningful dialogue focused on improvement	–	–	2
Learner-Facilitator			
Overall Skills: professional/excellent/leadership	1[a]	1[a]	1[a]
Atmosphere Creation Ability: supportive of participation/neutral/comfortable/opportunities to respond	2	1[a]	–
Facilitation Skills: explicit in instructions/everyone kept on track	–	–	2
Mediation Skills: objective; effective mediator/ honest/non-judgmental	–	2	–
Learner-Learner			
Hearing ideas of others/group memory/collective voices/unanimity/learning from each other	1	2	1
Professionalism of groups	2	1[a]	2

[a] Most frequently mentioned item within all types of Helpful Interaction categories. Rank based on frequency count of items for All Sites, n = 207; for On-Campus Sites, n = 105; for Remote Sites, n = 102.

Table 3

Ranking of Student Comments Concerning Distance Education Evaluation Model Related to Types of Interaction by Site: Hindering Interactions

Types of Interaction in Evaluation Process	Sites All	Sites Campus	Sites Remote
Hindering Interactions			
Learner-Process			
Amount of time for process	1[a]	1[a]	1[a]
Time Limits	2	1	1
Personal feelings	2	–	2
Learner-Facilitator			
Facilitator monitor time	1	–	1
Learner-Learner			
Peer pressure	1	1	1
Feelings about self	2	–	2
No Problems			
Not difficult	1	1	1

[a] Most frequently mentioned item across all types of Hindering Interactions categories. Rank based on frequency count of items for All Sites, n = 207; for On-Campus Sites, n = 105; for Remote Sites, n = 102.

Table 4

Ranking of Student Comments Concerning Distance Education Evaluation Model Related to Types of Interaction: Change Interactions

	Sites		
Types of Interaction in Evaluation Process	All	Campus	Remote
Changes Interactions			
Learner-Process			
Conduct earlier in the semester	1[a]	1[a]	1[a]
Provide the questions prior to the session	2	2	2
No Changes			
Continue/don't change	1	1[a]	–
Would like to use format	2	2	–

[a]Most frequently mentioned item across all types of Change Interactions categories. Rank based on frequency count of items for All Sites, n = 207; for On-Campus Sites, n = 105; for Remote Sites, n = 102.

Figure 1. Percentage Distribution by Sites for Items on Effectiveness of Small Group Instructional Diagnosis

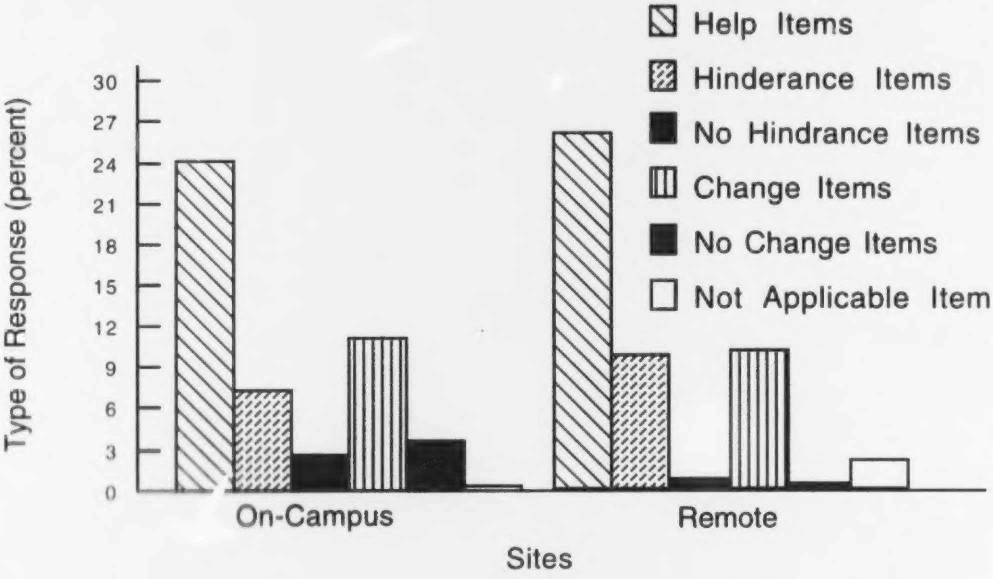
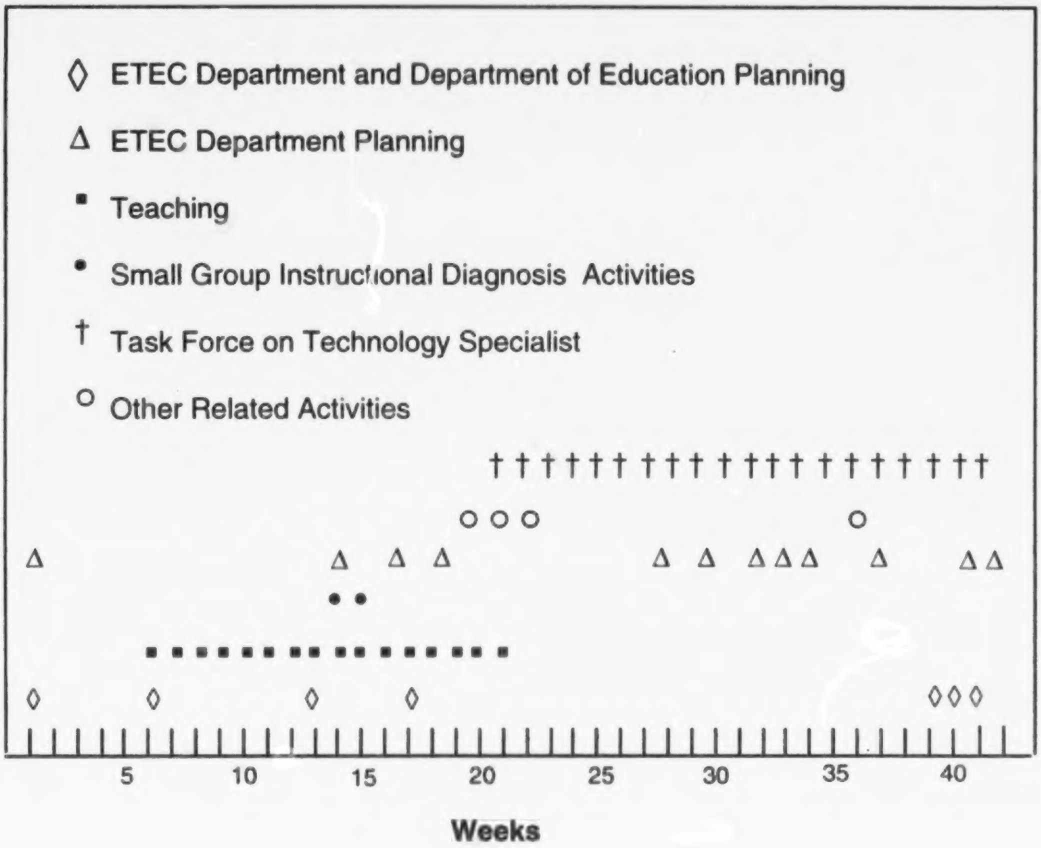


Figure 2. Timeline of Activities in Relation to Small Group Instructional Diagnosis


◊ ETEC Department and Department of Education Planning
Δ ETEC Department Planning
▪ Teaching
• Small Group Instructional Diagnosis Activities
† Task Force on Technology Specialist
○ Other Related Activities
5
10
15
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30
35
40
Weeks

Title:

Sharing Across Disciplines -- Interaction Strategies in Distance Education
Part I: Asking and Answering Questions

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Abstract

This study examines learner perceptions of the ease of asking and answering questions with the instructor and other learners in the interactive television classroom. Using a Likert scale based survey, learner perceptions were collected from 235 individuals from both studio and remote sites in eleven courses offered through the Hawaii Interactive Television Classroom (HITS). Learners from the remote site locations rated the interactive TV classroom as significantly easier for asking and answering questions than the traditional setting, while learners from the studio groups did not rate the two situations as significantly different. The learner location (studio or remote) or type of communication (ask or answer) did not have a significant effect on learner perceptions of the ease of communication with the instructor. When asking and answering questions with other learners, learners at the remote site perceived these communication behaviors as significantly easier than learners at the studio sites. Overall, learners perceived sending answers to be easier than asking questions when communication with learners at a different site, but they found asking questions to be easier than answering questions when communicating with learners at the same site. The results of this study indicate that characteristics of the interactive television classroom can affect learner's perceptions of the communication process and instructors need to pay attention to the effects of these characteristics when planning TV courses.

Introduction

Is television easier? According to Salomon (1983) "learning in its generic sense, greatly depends on the differential way in which sources of information are perceived, for these perceptions influence the mental effort expended in learning" (p.42). The Salomon model proposes that the amount of learning via a given medium is proportional to the amount of invested mental effort (AIME). Although the argument is well made in a study comparing reading and educational television, Miller, McKenna, and Ramsey (1993) caution against extrapolating these findings to distance education. They argue that two-way interactive television is more comparable to the traditional classroom than to educational television and should have similar results.

Previous research comparing the traditional and the interactive distance forms of instructional delivery has shown no significant differences in student learning outcomes. In a study on audio teleconferencing, Weingand (1984) found students in both traditional and distance classes had similar achievement levels. Students in a television course with two-way audio also showed no differences in content learning (Haynes & Dillon, 1992). Ritchie and Newby (1989) conducted a study comparing a live interactive television course and a classroom lecture course and found student achievement to be the same in both formats. A literature review by Whittington (1986) supports these findings; in terms of student achievement and learning outcomes, the traditional and interactive distance forms of instructional delivery do not differ significantly.

Achievement may be the same, but research comparing interaction in the traditional and distance education settings has shown students interact less in the distance classroom. Students at distance sites tended to ask fewer questions (Barron, 1987) and interacted less with the instructor (Haynes & Dillon, 1992). Ritchie & Newby (1989) found students in a traditional setting interacted twice as often and used a greater variety of interaction types than the students in the television setting.

Although learning outcome is an important measure of the success of any educational program, it is not necessarily the only measure of success. Hackman and Walker (1990) point out that grades alone are not a complete estimate of students' learning and satisfaction. Garrison (1990) suggests that the quality of an educational learning experience is dependent upon two-way communication. The teacher should not just report information, and the student should not be a passive learner. Quality education requires opportunities through dialogue and discussion for the student to challenge the ideas of the teacher and the meaning of the information. The cognitive speed theory (Fulford, 1993) suggests in one-way communication only half of the learner's cognitive capacity is being utilized. This means the potential for distraction is increased. When a learner is not engaged in a situation, renegade thought patterns are likely to occur. Interaction and anticipated interaction are ways of keeping learners engaged.

Past research has found that student satisfaction and perceived learning are affected by the availability of interaction. When students had the opportunity to comment on lectures, satisfaction and perceived learning were greater (Hackman & Walker, 1990). When students interacted regularly with the instructor and other students, they reported increased motivation and higher quality learning experience (Garrison, 1990). Fulford and Zhang (1993) found that students' perceptions of high levels of classroom interaction corresponded to higher levels of satisfaction.

Interactive forms of distance education such as audio tele-conferencing and television classrooms try to approximate the traditional face-to-face classroom. These systems of instructional delivery depend on communication technology to allow interaction (Garrison, 1990). Garrison contends the quality of distance education programs depends on the technological capability of the system to provide frequent and regular interaction. Even though learning outcomes are comparable, distance education programs may be inferior to the traditional classroom setting when interaction is inhibited.

Kozma (1991) argues that a learner uses the medium of instruction as well as the content to create knowledge and the capabilities of the medium influence the learner's information processing. This means different media with different attributes and capabilities can produce different learning. The medium being considered in this study is the two-way interactive television form of instructional delivery. Kozma (1991) suggested the learning process is sensitive to external environmental characteristics such as the availability and structure of information.

Hackman and Walker (1990) suggest even though learning outcomes are the same, there are some fundamental differences between the two forms of instructional delivery. Some of these differences are overt and may relate to limitations of interaction. In the television course with two-way interactive video, students at the remote sites and in the studio must use microphones to communicate with the instructor or with students at other sites. Students must also speak to the camera in order to approximate eye contact and must see themselves on the television screen when speaking. Ritchie (1993) pointed out that the television does not show the instructor at all times and all of the students are not shown at all times. In the traditional class, students always see the instructor, and the instructor always sees the students. Under the television conditions important non-verbal communication such as body language can be limited or totally missing (Fulford & Zhang, 1993; Ritchie, 1993). Some students report uneasiness in front of the camera, disliking the microphones, and high anxiety while on television (Nahl, 1993). These barriers may create additional mental effort and possibly make interactive television harder rather than easier.

The unique features of the interactive television classroom are components of the communication process. If students perceive these components as barriers to communication, interaction may be affected. Fulford & Zhang (1993) found that student perceptions of overall classroom interaction was a critical predictor of satisfaction. Notably, they found that students' perceptions of personal interaction level were not significantly related to actual interaction time (Zhang & Fulford, 1994). Hackman and Walker (1990) found students' perceptions of learning and satisfaction can be maximized by manipulating design features. These studies imply student perceptions can strongly affect interaction and satisfaction. Salomon's model of mental effort may be more relevant to student perceptions of interaction rather than achievement in interactive television.

Moore (1989) describes three types of interaction: learner-instructor, learner-learner, and learner-content. This study will focus on the first two types: learner-instructor and learner-learner. Because of the unique situation of the television classroom, both interaction types can be divided into interaction at the same site and interaction between different sites. In the traditional classroom, all the students are in the same room with the instructor, but in the television system only the studio site students are in the same room as the instructor.

Instead of looking at overall levels of interaction, this study focuses on specific behaviors: asking questions and answering questions. These behaviors can be seen as important starting points or integral components of interactive dialogue. If students perceive barriers to asking and answering questions, interaction may be seriously curtailed.

The purpose of this study is to investigate learner perceptions of the ease of asking and answering questions in the TV classroom and, how these perceptions are affected by the location of the individual sending the message, the location of the individual receiving the message, and the type of message being sent.

Three research questions have been posed:

RQ1. Do learners at the studio site and remote sites perceive it easier to ask and answer questions in the traditional class or the interactive TV class?

RQ2. When interacting with the instructor, does the learner's location (studio or remote) affect the perceived ease of asking and answering questions?

RQ3. When interacting with other learners does the sender's location (studio or remote) and the receiver's location, the destination (same or different), affect the perceived ease of asking and answering questions?

Methods

Participants were 235 students enrolled in courses taught over the Hawaii Interactive Television System (HITS). HITS is an electronic communication system used by the University of Hawaii to deliver courses on outer islands as well as off-campus sites on Oahu. It is a four-channel interactive closed circuit television network that uses both Instructional Television Fixed Services (ITFS) and point-to-point microwave signals. Participants were from campuses on Manoa (N=105), Maui (N=87), Kapiolani Community College (N=14), Kauai (N=20), and Hilo (N=9). Students at the Manoa site were in the studio group (N=105). The students at Maui, Kapiolani Community College, Kauai, and Hilo were in the remote group (N=130). Participants were enrolled in one of eleven different courses offered by the departments of Educational Administration, Political Science, Educational Technology, Nursing, Business Administration, Public Health, Educational Curriculum and Instruction, and Hawaiian Studies. The data were collected during the Summer Session and Fall Semester of 1994.

A questionnaire was developed in order to measure learner perceptions of the ease of sending messages in the TV classroom. The survey had three sections: interaction with the instructor, interaction with learners at a different site, and interaction with learners at the same site. The heading for each section was "Compared to the traditional face-to-face classroom, I feel in this TV class..." The items were completions of this statement. Each section contained three parallel items about the ease of asking questions and three parallel items about the ease of answering questions for communication with the subject of that section. Students responded to these items using a 7-point Likert scale with 1= strongly agree, 4= neutral, and 7= strongly disagree. For analysis, the items were scored so lower numbers indicated the TV classroom was perceived as easier. Each subject had mean sub-scores for: (a) perceived ease of asking questions with the instructor; (b) answering questions from the instructor, asking questions with learners from a different site; (c) answering questions from learners at a different site; (d) asking questions with learners from the same site; and (e) answering questions from learners at the same site.

A Cronbach's Coefficient Alpha of .89 was calculated for the overall reliability of the survey. For the subsection Asking Questions a reliability of .72 and for Answering Questions a reliability of .75 were calculated.

Results and Discussion

Do learners at the studio site and the remote sites perceive it easier to ask and answer questions in the traditional class or in the TV class? (RQ1) Single sample t-tests were conducted for both studio and remote groups on the dependent variable perceived ease of sending messages. The Studio site ($n = 97$) had a mean of -.02 (SD .83, $t = -.24$). The Remote site ($n = 121$) yielded a mean of .19 ($SD = .64$, $t = 3.34$). Table 1 reports the results of the t-tests for both the studio and the remote groups.

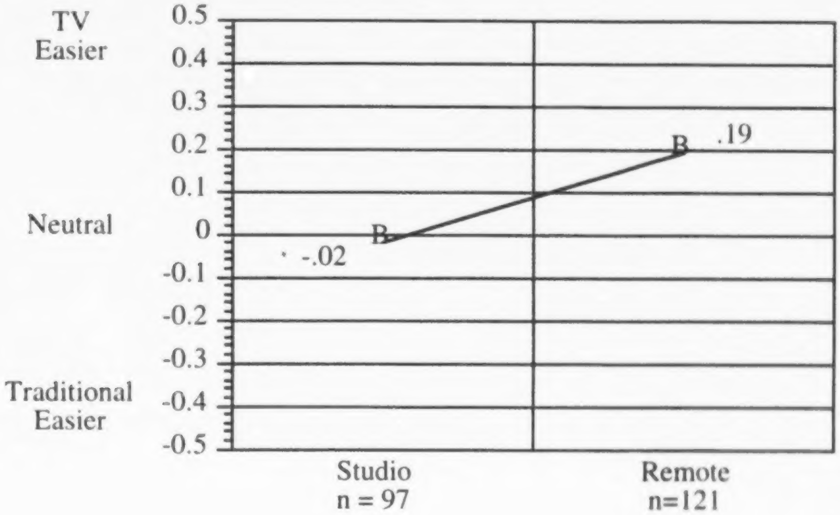
Table 1. Descriptive Statistics for the Single Sample T-Test

Site	N	Mean	SD	T
Studio	97	-.02	.83	-.24
Remote	121	.19	.64	3.34*

* p<.01

As shown in Figure 1, a mean = 0 would indicate that the perceived ease of sending messages was the same for the traditional and the TV methods of instruction. A positive mean would indicate sending messages in the TV class was perceived to be easier, and a negative mean would indicate the traditional class was perceived as easier for sending messages. Learners from the remote site locations rated the TV classroom as significantly easier for asking and answering questions than the traditional setting. Although significant, the effect size was relatively low, Cohen's *d* = .29. Learners from the studio class did not rate the two as significantly different.

Figure 1. TV vs. Traditional in a Single Sample T-Test.



For the studio group, the most obvious differences between the TV and the traditional settings is the presence of the technical equipment in the TV class. This equipment does not seem to make the TV class different in terms of the perceived ease of sending messages. For the remote group, the differences include the technology and the absence of the instructor. Perhaps not having the instructor in the same room creates a less intimidating situation where the learner feels it easier to send messages. This may be particularly true with the population unique to Hawaii that is composed of many cultures, predominantly Asian. With a small effect size and an atypical population, caution should be observed when extrapolating these results. Further research is needed to confirm these results with other cultural groups.

When interacting with the instructor, does the learner's origination site (studio or remote) affect the perceived ease of asking and answering questions? (RQ2) A 2x2 ANOVA with repeated measures on the independent variable message type was conducted. The independent variable message type had two levels: ask and answer. The independent variable sender location had two levels: studio and remote. (See Figure 2.) The learner location (studio or remote) or type of communication (ask or answer) did not have a significant effect on learner perceptions of the ease of communication with the instructor. These results indicate being physically separated from the instructor does not affect how easy learners feel it is send questions and answers. Perhaps the instructors in these courses have been able to successfully use strategies that facilitate learner-instructor interaction

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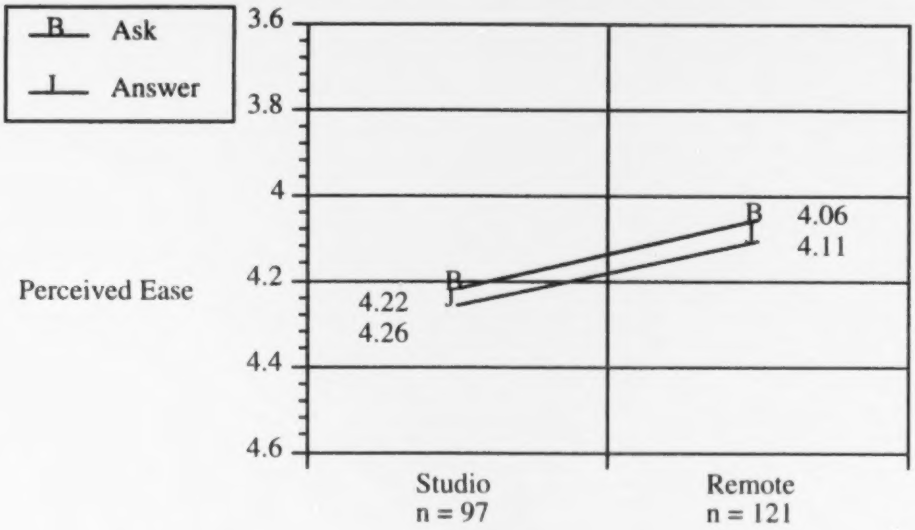
Figure 2. Communication with the Instructor using 2-Way ANOVA Repeated Measures.



When interacting with the other learners, does the learner's origination site (studio or remote) and the destination site (same or different) affect the perceived ease of asking and answering questions? (RQ3) A 2x2x2 ANOVA with repeated measures on the independent variables, message type and destination, was conducted. The first independent variable, message type, had two levels: ask and answer. The second independent variable, sender location, had two levels: studio and remote. The third independent variable, destination, had two levels: same site and different site. Table 2 shows the means of the different groups and Table 3 shows the results from the ANOVA. The main effect learner location was significant ($df = 1$, $F = 6.07$, $p<.05$). Learners at the remote site perceived asking and answering questions with other learners as significantly easier than the learners at the studio sites. Again, not having the instructor physically present in the classroom may have a relaxing effect. The learners may feel they can more easily interact with other learners without disturbing the lecture.

Table 2. Descriptive Statistics for 3-Way ANOVA

	Ask				Answer			
	Different		Same		Different		Same	
	Mean	SD	Mean	SD	Mean	SD	Mean.	SD
Remote	4.37	1.40	2.97	1.05	4.07	.94	3.24	.97
Studio	4.55	1.38	3.36	1.19	4.23	1.10	3.52	1.25

Table 3. Learner to Learner Communication using a 3-Way ANOVA with Location, Message and Destination

Source	SS	df	MS	F
Location	13.62	1	13.62	6.07**
Message	.36	1	.36	.43
Destination	238.72	1	238.72	136.94*
LocatXMess	.21	1	.21	.26
DestXLocat	1.52	1	1.52	.87
DestXMess	15.91	1	15.91	25.55*
DXMXL	.13	1	.13	.64

* $p<.01$ **$p<.05$

The main effect of message was not significant. Overall learners perceived no difference between the ease of asking and answering questions. However, the main effect of destination was significant (*df* = 1, *F* = 136.94, $p<.01$). Learners perceived it to be significantly easier to ask or answer questions at the same site rather than at the a different site. These results suggest the importance of the physical presence of the other learner in learner-learner interaction. Learners have limited contact with other students at different sites. Different site students are not viewed on the screen very often, and usually the whole class will be shown from a distance rather than close-ups of each individual. Interaction with other learners at the same site can be informal and does not require the use of technology. In order to interact with a learner at a different site, the microphones, TV's, and cameras must be used.

The interaction effect, destination by message type, was significant (*df* = 1, *F* = 25.55, $p<.05$). (See Figure 3 and 4.) Learners perceive sending answers to be easier than asking questions when communicating with learners at a different site; however, they found asking questions to be easier than answering questions when communicating with learners at the same site. When communicating in the TV classroom, directing a question to a learner at a different site is perceived as harder than responding to a question posed by a learner at a different site. Perhaps answering is easier because a response has been prompted, while asking a question requires initiating a communication behavior with a physically and possibly psychologically distant individual. If learner to learner interaction is more informal and occurring while the instructor is lecturing, then answering a question from a learner at the same site may mean missing transient information. The learner asking the question is willing to miss information, the individual being asked may not want to divert attention away from the instructor.

The interaction effects of location by message and destination and location were not significant. Learners at both studio and remote sites perceive asking and answering questions with the same relative ease. Also, as would be expected, learners at both studio and remote sites perceive it easier to ask or answer questions within the same site rather than a different site. The three-way interaction effect destination by message type by learner location was not significant. The pattern of the destination by the message type interaction is the same for both the studio and remote sites. This is shown graphically by comparing of Figure 3 and Figure 4.

Figure 3. Learners at the Remote Site with Same Site and Different Site Learners using a 3-Way ANOVA with repeated measures on Message and Destination.

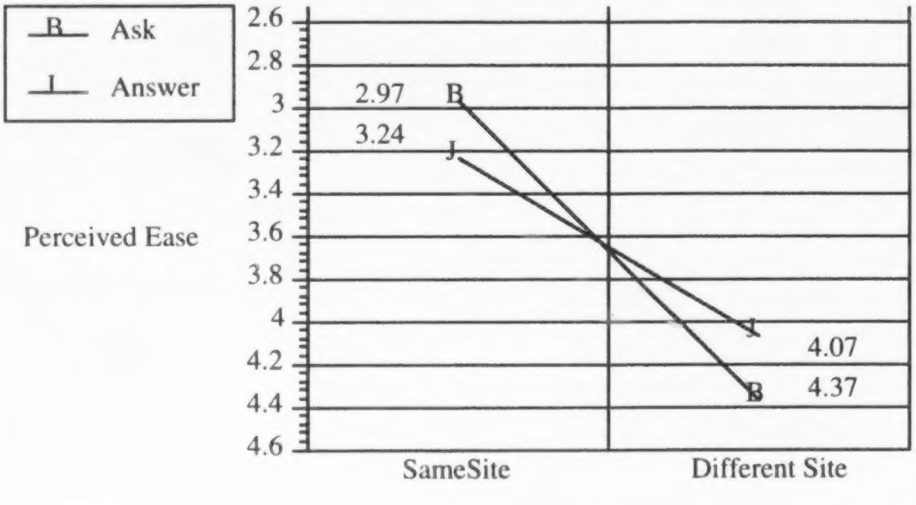
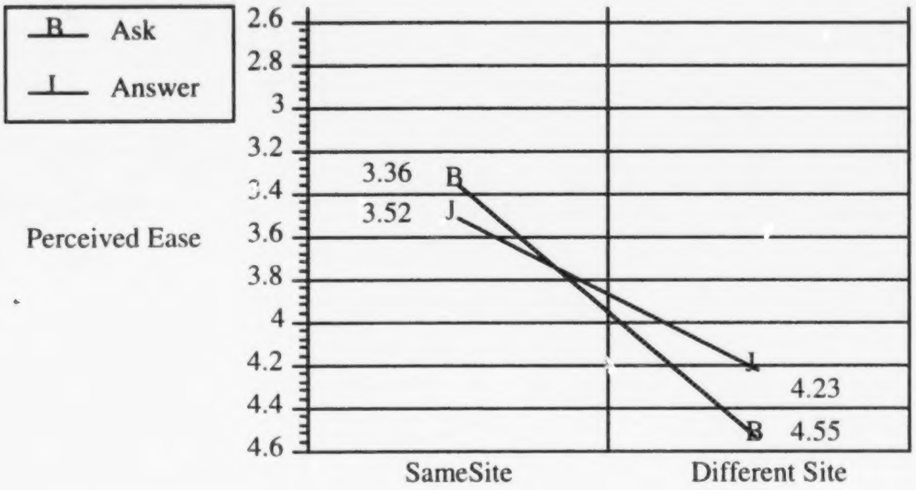


Figure 4. Learners at the Studio Site with Same Site and Different Site Learners using a 3-Way ANOVA with repeated measures on Message and Destination.



Conclusions

The results of this research indicate certain attributes of the interactive television classroom do significantly affect the learner's perceived ease of asking and answering questions. Instructors should be aware of these effects when planning courses to be taught over the television. Based on the results of this study, future research can be directed into studies on other effects of the TV medium on learning processes. Achievement in the traditional and television classrooms may be the same, but other differences between the two can still be found.

The media characteristics of two-way television seem to create greater barriers between learners across sites than between learners and the instructor or learners at their own site. The design of the system commonly disallows visual contact between learners at the various sites. TV monitors for all sites are often only present at the studio site, and depending on the set-up may not be easily visible even by the studio learners. Visual contact is dependent on the instructor or technician choosing to show an individual, group of students, or site on the program monitor. In an interview with students at a remote site, students said that it was easier to interact with the instructor than with the other sites simply because you can see them. However, when other sites were put on the screen, interaction was easier. To improve results with student centered learning and increase learner to learner interaction, future research should examine system features that reduce visual barriers between students.

Since improving system design can be costly, instructional design may be able to provide a more immediate solution. Instructors should work towards improving strategies to increase the visibility of individual students earlier in their courses. Learner to learner activities across sites may increase the students' connection to each other. Electronic mail and other personal communications could serve as a vital link for collaborative projects. Students should be encouraged to share their thoughts with others in the system rather than depending only on their site mates for interaction. Research into the changing culture of the classroom that examines the "TV room" atmosphere of the distance classroom may be important to fully understand the interactive behavior of learners.

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Title:

The Impact of Closure on Satisfaction with Group Decision-Making

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Abstract

Satisfaction is a construct that is important to the development of intrinsic motivation and the continuing effort to learn. Research that helps to identify those factors that contribute to satisfaction is useful in the design of electronic support systems for individuals and groups. This paper investigates the impact of "need for closure" on information processing and decision confidence (as signified by closure) and the subsequent relationship between confidence and satisfaction with the outcomes of a group decision-making task . This paper presents a brief review of the literature related to closure and satisfaction, then describes the Cognitive-Motivational Model of Group Member Decision Satisfaction, and concludes with the results of an initial empirical research study of this model with groups using either a computer-based group system or a manual method for supporting group decision-making.

Introduction

Groupwork has become an important focus of research in education, as evidenced by the growing amount of research on cooperative learning in all educational contexts (e.g. Johnson, Johnson, & Stanne, 1985; Hooper, 1994; Hooper & Hannafin, 1991). Research indicates that students working in cooperative groups are more successful at high level skills such as problem solving and decision-making than when working alone. Group learning situations may include such experiences as simulations, debates, group projects, and case study analyses. In such situations, a group is often faced with a problem or set of problems and the task involves reaching consensus and forming a group judgment or decision.

Although there has been considerable attention in the education literature to the effects of group learning on achievement (e.g. Johnson & Johnson, 1989; Slavin, 1990; Hooper & Hannafin, 1991), until recently there has been considerably less attention paid to affective outcomes, such as satisfaction, with group work, specifically group decision making. Yet, when assessing a decision, group member satisfaction is a critical variable and may play a significant role in decision implementation (Maier, 1970) and group effectiveness (e.g. Van de Ven & Delbecq, 1974).

Despite being a frequently-used research variable, satisfaction has not been adequately conceptualized or defined (Hecht, 1978). When people are asked if they are satisfied with a particular activity or outcome and they say "yes," what does that mean? Does it mean that the task was enjoyable, rewarding, and/or important? Does it mean that they would do more of it or do it again? Thus, research on group member satisfaction may serve two purposes. From a theory-building standpoint, satisfaction can serve as a criterion for research evaluating other variables (Smith, et al., 1966). From a practical standpoint, the study of satisfaction may have direct implications for the conduct of group-based tasks like group decision-making.

Our theory of group member satisfaction is based on Kruglanski's (1989) cognitive-motivational theory of closure, where closure is defined as subjective certainty, reflecting a state of firm knowledge. This state, once attained, signals a degree of closed-mindedness, i.e. the point at which new information bearing on the decision problem will not be actively sought by the decision-maker (Kruglanski, 1989). As a result, we reason that the attainment of closure will be an important component of group member satisfaction with the decision and we have developed a model based on that assertion. This paper reviews some of the related literature, builds on our Cognitive-Motivational Model of Group Member Decision Satisfaction [formerly Closure Model of Decision Satisfaction (Small & Venkatesh, 1994)] and presents the results of an initial research study testing this model.

Closure

The Random House Dictionary of the English Language (1987) defines closure in terms of psychological completeness or certainty]. Closure has been a topic of study in at least three areas---education, management, and psychology.

Educational researchers have tended to focus on the former component without defining "closure" in operational terms. The importance of closure in accomplishing a learning task has been recognized frequently in the education literature. Dubelle (1986) describes closure in terms of outcomes of an activity that bring the major points of a lesson into focus so they may be perceived as an organized whole. Keller (1983) emphasizes a learner's need to perceive various pieces of content as fitting into a whole, thereby experiencing closure and a sense of accomplishment. Ziergarnik (1967) emphasizes the need to bring an instructional task to closure and Brophy (1987) contends that students experience a sense of accomplishment when they complete meaningful tasks. Wlodkowski (1991) advocates attaining "positive closure" as a motivational element in adult education "because it affirms the entire learning process, reinforces the value of the experience, directly or indirectly acknowledges competence, increases cohesiveness within the group, and encourages the surfacing of inspiration and other beneficial emotions within the learners themselves" (pp 247-248). They all refer to closure as an end state that reflects the accomplishment of a task.

Closure has also been addressed in the management literature on group research but no-one has clearly defined it. In a study comparing interacting nominal group technique (NGT) and delphi groups, Van de Ven and Delbecq (1974) found NGT groups attained "closure," while delphi groups attained "closure with detachment" and interactive group meetings tended to conclude with "high perceived lack of closure." Notably, NGT members were also more satisfied with group process and performance, suggesting a positive link between closure and satisfaction. The authors, however, fail to make such a link and never define closure, conceptually or operationally.

Hagen & Burch (1985) found that the perception of "closure" on a group task was positively related to member satisfaction. However, they, too, do not not define closure. It is also unclear whether satisfaction was due to process factors and/or task outcomes. Bostrom et al. (1993) identify "lack of closure" as one of the major problems behind unproductive meetings; "lack of closure" here describes meetings that typically generate no published outputs, run too long, or are generally inconclusive. Anderson & Robertson (1985) see the human facilitator as promoting "closure" through a mediated resolution of issues. While these references are intriguing, no operational definition of closure is advanced.

Closure has been explored more thoroughly in the psychology literature, most notably by Kruglanski. Kruglanski (1989) incorporates "closure" into a cognitive-motivational theory of knowledge and cognition in which a "need for closure" is assumed to motivate a person to prefer certainty over indeterminacy. Need for closure, largely a situation variable, is imposed by factors in the environment, such as time constraints, a desire to move on to other matters, or the fear of an inaccurate decision.

Closure is an end state, characterized by confidence in the possession of a definite, unambiguous answer to a question, "as opposed to confusion or ambiguity" (Kruglanski & Freund, 1983, p. 450). While a person's need for closure may be characterized by high (hereafter referred to as need to expedite) closure or low (hereafter referred to as need to delay) closure, the underlying concept reflects a "quest for assured knowledge that affords predictability and a base for action" (Kruglanski, 1989, p. 14). Closure theory posits that information processing in judgmental situations is influenced by the decision-maker's need for closure as specified on a continuum of openness to new information (or degree of close-mindedness) (Kruglanski, 1989). Although possibly influenced by individual differences variables (e.g. tolerance for ambiguity, trait curiosity), need for closure is largely a situation-specific variable whereby costs and benefits are assumed to affect level of need for closure when the individual's current state differs from a desired end state. Therefore, the individual must perceive closure as a current benefit in order to have a need to expedite closure sooner rather than later. However, the theory does not consider the affective consequences of either attaining or not attaining closure.

In a need to delay closure state, allowing additional information to be considered, and keeping an open mind before commiting to a decision or course of action because the perceived benefits of delaying closure outweigh the costs of lacking closure. need to delay closure tends to emphasize accuracy (requiring more time on task), while need to expedite closure tends to emphasize other goals (e.g. the need to see oneself as decisive), with accuracy assuming a less critical role. For example, when a decision or action is consequential (e.g. an actual courtroom murder trial), it is reasonable to assume that the decision-maker (juror), given a choice, would delay making a decision in order to process information more extensively before rendering a judgment, given the high cost of judgmental error inherent in the situation (convicting an innocent person). A low need to attain closure tends to emphasize accuracy to avoid the high cost of error. However, even in need to delay closure situations, as in the above example, an individual will be motivated to eventually attain closure. Only under certain circumstances will decisions be avoided altogether (Corbin, 1980; Mann & Janis, 1982).

In a state of need to expedite closure, the decision-maker wishes to expedite closure because the perceived benefits outweigh the costs of lacking closure. For example, when a decision is relatively less consequential (e.g. a mock trial), the decision-maker (e.g. student juror) may be more willing to render a quick judgment where the perceived benefits of closure (e.g. more time to do other things) outweigh the perceived costs of lacking closure (e.g. the need to invest additional information processing time and effort). High need to attain closure is strongly influenced by such factors as self-esteem or cognitive consistency, as well as the need for accuracy (Pyszczynski & Greenberg, 1987).

The need for closure also influences the information processing component of the decision-making process (Guzzo, 1982). Uncertainty reduction stimulates information seeking and maintains information acquisition behavior (Lanzetta, 1963). When an individual understands that he has an "information gap" between what he knows and what he wants or needs to know, he will be motivated to seek out the information he needs to close that gap (Lanzetta, 1963).

In decision-making situations, information processing includes both hypothesis generation (i.e. possible solutions based on the information received) and hypothesis evaluation [i.e. selection of the most efficacious solution(s)] (Gettys, Mehle, and Fisher, 1986; Kruglanski, 1989). Mayseless & Kruglanski (1987) found less extensive information processsing was needed to produce a confident judgment under need to expedite closure than need to delay closure conditions (which was experimentally induced by heightening the fear of invalidity and, hence, the need for judgmental accuracy). In the need to delay closure condition, more extensive information processing was required for subjects to feel confident enough to render a judgment believed to be accurate.

Closure and Affect

We extend Kruglanski's (1989) closure theory to include affect. That is, to the extent that a decision-maker is motivated to close the gap between a current state of lack of closure and a desired end state of closure, we posit that attaining that desired end state will promote positive affect, while failure to attain it will cause negative affect, in both high and need to delay closure conditions. In general terms, group member satisfaction is an affective response to some type of cognitive appraisal of accomplishment of a group task, process, composition, or decision (Witteman, 1991; Collins & Guetzkow, 1964). Researchers have found group member satisfaction highly correlated with degree of task accomplishment (e.g. Heslin & Dunphy, 1960; Marquis, Guetzkow & Heyns, 1951), the context on which our research focuses. However, it is unclear from the literature what the appraisal process involves (i.e. how one decides that the task has been adequately accomplished) or how cognitive appraisal (i.e. closure) and the affective response are linked (Hecht, 1978).

Our theory represents the decision-maker as an active evaluator of the adequacy of information processing, using what Corbin (1980) calls the "uncertainty cutoff" as the subjective standard of appraisal. We assert that information processing will continue until the decision-maker has attained the required level of confidence with the knowledge he/she possesses at that point (a subjective assessment) and decides to decide. Closure theory posits that information processing in judgmental situations is influenced by the decision-maker's motivation (need for closure) as specified on a continuum from low to high (Kruglanski, 1989). When this state of closure (or decision confidence) is reached, the decision-maker will halt information processing (albeit temporarily) and make a decision. Thus, satisfaction with the decision at the time the decision is made is the affective outcome of having attained the desired cognitive end state of closure.

Closure should be a stronger predictor of decision satisfaction in need to delay closure conditions than in need to expedite conditions. That is, the strength of the relationship between closure and decision satisfaction will vary depending on whether epistemic motivations emphasize accuracy or other goals. When accuracy is emphasized, confidence (resulting in closure) will be a strong predictor of decision satisfaction, reflecting high subjective value placed on confidence in such situations. When other goals dominate, decision confidence will be a relatively weaker predictor of decision satisfaction.

Group Member Satisfaction

Porter & Lawler (1968) found a relationship between performance and satisfaction in the workplace, where the success of the former is a cause of the latter. In learning situations, satisfaction is often described as the sense of accomplishment that learners feel at the conclusion of a learning event when outcomes of their efforts are consistent with their expectations (e.g. Keller, 1983).

Typically satisfaction is defined and measured in overly simplistic, unidimensional terms (e.g. Was it fun? Are you satisfied?) Klein & Pridemore (1992) measured satisfaction using six related items from the Instructional Materials Motivation Scale (Keller, 1987). In addition to using enjoyment and feeling good, and pleasure as descriptors, the items described satisfaction in terms of "accomplishment," and "practice and feedback."

Some current research points to a relationship between satisfaction and other constructs. For example, Small and Gluck (1994) used a magnitude scaling method to investigate adult student perceptions of the relationships of 35 instructional attribute terms to four major motivational components (attention, relevance, confidence, and satisfaction) comprising Keller's ARCS Model of Motivational Design (e.g. Keller, 1983), a model largely based on expectancy-value theory (Porter & Lawler, 1968). Their results found that feedback and related terms (encouragement, praise, supportiveness) were among the most closely associated to satisfaction. In addition, they explored relationships among the four ARCS components. They found that confidence and satisfaction shared seven of the ten closest attributes. They also found that the attributes related to confidence and satisfaction were significantly different than those related to attention and relevance. They point to this as evidence supporting Keller's claim that the confidence and satisfaction conditions are closely related to each other, as well as with the "expectancy for success" factor of expectancy-value theory, while attention and relevance conditions are aligned with the "value" factor.

Conceptually, satisfaction derives from an affective or emotional response to a situation. Arnold (1960), in a now widely-accepted characterization, saw satisfaction as an outcome of an appraisal process, with situations "seen as favorable to one's well-being...appraised positively, while those seen as inimical...appraised negatively" (Locke & Latham, 1990, p. 226). A performance goal may serve as the value standard used to assess performance, with positive affect resulting if the standard is exceeded and negative affect when the standard is not met (Locke, 1976).

Often the focus of research is on the individual learner's satisfaction following successful completion of a task. However, when learners are required to work in groups, use group processes, accomplish group goals, and be assessed according to group outcomes, group member satisfaction may not reflect individual satisfaction; i.e. an individual could be satisfied that the group reached a group-level goal but is personally dissatisfied with the result or process (Small & Venkatesh, 1994). This research examines individual satisfaction with accomplishment of a group task.

The Model

Our work extends Kruglanski's (1989) cognitive-motivational perspective to examine decision satisfaction, as researchers have stressed the value of studying satisfaction (e.g. Smith et al., 1957) and decision-making (Corbin, 1980) in motivational terms. The cognitive-motivational perspective on closure centers on information processing effects. As information processing is central to group decision-making (Guzzo, 1982) and GSS environments (DeSanctis & Gallupe, 1987), we reasoned that closure, as a variable associated with information processing, would predict decision satisfaction.

The Cognitive-Motivational Model of Group Member Decision Satisfaction (presented in Figure 1) was first developed at the individual level and then considered in the group environment (Small & Venkatesh, 1994). This model provides a theory-based linking of motivation, information processing, confidence (signifying closure) and satisfaction. This model is based on the following predictions regarding decision satisfaction: (1) if closure is desired or valued (e.g. the cost of judgmental invalidity is low and/or the benefit of rendering an expeditious judgment is high), rendering such a judgment will promote positive affect in the decision-maker and conversely (2) in situations where closure is not desired or valued (the cost of judgmental invalidity is high so the decision-maker has a compelling incentive to "keep an open mind" and delay or postpone making a decision), the decision-maker will experience negative affect if forced to render a judgment (e.g. due to imposed or perceived time constraints). In motivational terms, the first situation signifies a need to expedite closure (confidence) (Kruglanski, 1989). The Cognitive-Motivational Model of Group Member Decision Satisfaction posits a number of paired relationships including need for closure and extent of information processing, information processing and confidence (signifying closure), and confidence and satisfaction. Each are explained briefly below.

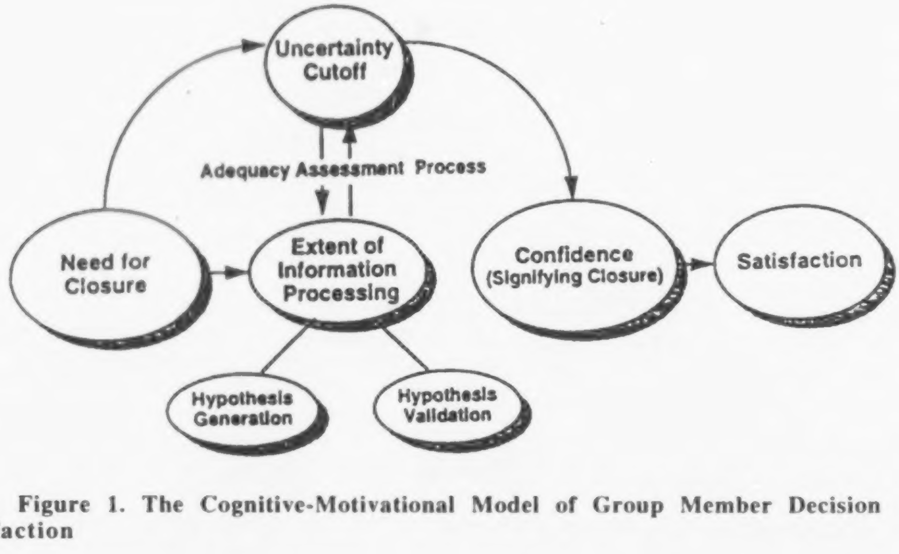
Uncertainty Cutoff
Adequacy Assessment Process
Need for Closure
Extent of Information Processing
Confidence (Signifying Closure)
Satisfaction
Hypothesis Generation
Hypothesis Validation

Figure 1. The Cognitive-Motivational Model of Group Member Decision Satisfaction

Need for Closure and Extent of Information Processing. Need for closure (high versus low) regulates the extent of information processing (Kruglanski,1989); i.e. in general, information processing tends to be more extensive (breadth) as well as more intensive (depth) in low (versus high) need for closure conditions (Mayseless & Kruglanski, 1987). Lanzetta (1963) states that under conditions of heightened uncertainty active information acquisition and processing is more probable. He found that for any level of uncertainty, information seeking will be greater the more important the consequences of the decision. Let us consider the individual situations of deciding when to submit a course term paper and when to submit a doctoral dissertation. For the former, need to expedite closure will likely be high, due to perceptions of possible external factors such as time constraints (e.g. inflexible due date), lower comprehensiveness requirement (e.g. 10-page maximum), or less emphasis on quality (e.g. only one of several assignments considered for a grade). However, for the latter the need to delay closure may be quite high and information processing will likely continue for a much longer period of time due to the high cost of error (e.g. submitting an inadequate literature review; insufficient statistical analysis).

Information Processing and Confidence. Confidence, a key outcomes in decision making, signifies certainty (Sniezek, 1992). Information processing and confidence are reciprocally linked; i.e. information processing is undertaken to reduce the level of subjective uncertainty inherent in a decision until the "uncertainty cutoff" is reached, decision confidence is high, and the "timing of choice" is at hand (Corbin, 1980). This cutoff is subjectively defined with reference to a level of confidence that the decision-maker deems acceptable. In the above example, the uncertainty cutoff is most likely to be reached much earlier for the term paper than for the dissertation. If, however, confidence is below the uncertainty cutoff, the decision-maker may be motivated to avoid or delay a decision, which could happen in either of the above examples. Using the uncertainty cutoff idea, our model augments Kruglanski by specifying the motivation behind the decision to halt (albeit temporary) information processing and the decision to decide.

But, one might wonder, what constitutes an acceptable level of confidence and by what criterion is the uncertainty cutoff subjectively defined? A "cost-benefit" analysis of the effects of difference need for closure motivations on the extent of information processing suggests that, for need to expedite conditions, reducing the cost (to the decision-maker) of judgmental invalidity and/or increasing the benefit of rendering an expeditious judgment will limit information processing. Conversely, in need to delay closure conditions, increasing the cost of judgmental invalidity fosters extensive information processing (Kruglanski, 1989).

Intensive processing of available information or gathering more information provide an alternative means "for decreasing uncertainty and for inducing the readiness to decide" (Corbin, 1980, p. 54). Need for closure will regulate information processing until the subjectively-set uncertainty cutoff is exceeded (or some external force intercedes), at which point it will be halted (albeit temporarily) and a decision made. This perspective implies a decision-maker who actively assesses the costs versus benefits of processing information in light of a subjective need for closure. Arguably, then, information processing that is judged as adequate under need to expedite conditions may be judged as inadequate under low need for closure conditions. The student writing the term paper (need to expedite) may decide to stop processing information and complete the task by the due date in order to avoid getting a lower grade for handing in the paper late. The student writing the dissertation (need to delay closure) may decide to delay submission of a final product when she learns of an alternative line of research from another discipline that she has not included in her literature review and believes it will better prepare her for her oral defense. The latter decision-maker would have to be more confident than the former before choosing to halt information processing and make a decision to submit because the stakes will be perceived as higher. (It is assumed that the individual will eventually halt information processing and make a decision.) To summarize, it may be argued that (1) the uncertainty cutoff is defined with reference to the decision-maker's need for closure and (2) confidence during the adequacy assessment process will rely on the uncertainty cutoff to regulate the extent of information processing, with a decision being made when confidence exceeds the cutoff. In the following section, we briefly consider four factors that also appear to influence confidence in groups---group process, technology, social, and motivational factors.

Group Process Factors. Groups that process more information will likely be less confident about their decision due to exposure to multiple member views (Sniezek, 1992). This prediction goes counter to the assumption that more information may be processed to boost confidence (e.g. Lanzetta, 1963). This apparent contradiction may be due to a lack of clarity in the literature on the level at which confidence is measured. More research directly comparing decision confidence at the member and group levels is needed before the link between increased information processing and decision confidence is understood (Sniezek, 1992).

Technology Factors. Research on the use of computer-based group support systems (GSS) suggests that such systems facilitate information processing and exchange in group situations (DeSanctis &

Gallupe, 1987). Group support systems (GSS) are a set of networked electronic tools that facilitate group work, most often in business settings. They typically include software that allows participants to conduct group activities, such as anonymous electronic brainstorming and organization and ranking of alternatives.

To the degree that GSS-use increases the number of alternatives considered by the group (Benbasat & Nault, 1990), it could be argued that group confidence would decrease in GSS groups relative to unsupported groups (e.g. Sniezek, 1992). However, a distinction among types of GSS is needed here. GSS-support has been classified into group communication support systems (GCSS) and group decision support systems (GDSS) (Pinnsonneault & Kraemer, 1989). While the former support group communication processes and have a negative effect on decision confidence and satisfaction, the latter provide decision-aiding techniques intended to reduce uncertainty, resulting in increased decision confidence and satisfaction (DeSanctis & Gallupe, 1987). Our model would predict that, for choice tasks, member decision confidence and decision satisfaction should increase to the degree that GSS supports both hypothesis generation and validation.

Social Factors. The effects of group interaction on group performance and achievement have been widely explored (e.g. Hooper et al., 1994; Hooper & Hannafin, 1991; Webb, 1982). Specifically, Rohrbaugh (1981; 1979) and Ono & Davis (1988) found that group interaction and discussion may increase decision confidence in groups. The goal (explicit or implicit) of reaching consensus may also heighten group confidence. The need for closure may motivate group members to strive for consensus, and the push for consensus may be functionally equivalent to an individual's need for closure (Kruglanski & Webster, 1991).

Motivational Factors. Need for structure may be functionally similar to need for closure; i.e. in individual decision-making, stressing the value of order helps increase decision confidence (Mayseless & Kruglanski, 1987). In group settings, an implicit belief appears to be that "good process leads to good outcomes" (Sniezek, 1991, p. 149). This suggests that positive evaluations (e.g. feedback) of the group interaction process may positively influence decision confidence (Guzzo et al. 1986). Amount of time and effort expended on the task may also affect confidence, with evaluations being positive if people conclude they "worked hard enough (Mayseless & Kruglanski, 1987) and inflated confidence in self-assessments of high effort (Sniezek, 1991).

Confidence and Satisfaction. Closure is operationalized as a cognitive end-state characterized by the group member's confidence in the group decision. While need for closure may encourage close-mindedness toward new information on the topic, Kruglanski (1989) and others (e.g. Pyszczinski & Greenberg, 1987) conceptualize it as a situational index rather than an individual difference. In the model, confidence (a cognitive belief) is shown to predict decision satisfaction (affective attitude) (Fishbein, 1966). Although the two may be positively correlated (Sniezek, 1992; Gallupe, Desanctis & Dicson, 1988; Steeb & Johnston, 1981), they are conceptually distinct. Satisfaction represents an affective attitude toward a decision, while confidence represents a cognitive confidence as to the quality of the decision.

The Research Study

The research reported below represents an initial experiment testing our model. It examines the link between closure (cognitive response) and decision satisfaction (affective response) by manipulating motivation (need to delay versus need to expedite) in a laboratory environment using technology-based (GSS) and manual methods. "Need for closure" is an independent variable, while "confidence" as an end state, is a dependent variable. The terms "subjective certainty" and "confidence" are used synonymously (Sniezek, 1991). Information processing was analyzed on the basis of quantity of ideas.

The following hypotheses were advanced:

Hypothesis 1. Confidence and satisfaction (in decision making) will be positively correlated.

Hypothesis 2. Information processing variables (hypothesis generation and validation) will predict satisfaction through confidence and not directly.

Methods

This research constituted a pilot study for a subsequent larger study. This study was conducted in two phases. The first phase involved manual methods; the second phase involved VisionQuest TM; i.e. a technology-based group support system (GSS). As a result of the first phase, some minor modifications were made to the second phase.

Eighty-one undergraduate and graduate students were subjects enrolled in three college courses. Subjects received course credit for participation. Subjects were randomly assigned to groups (three subjects per group) (technology vs. no technology) and group conditions (need to delay vs need to expedite closure). Table 1 presents some demographic data for subjects in this study.

Group	Need to Delay Closure #Ss (#Grps)	Need to Expedite Closure #Ss (#Grps)	M	F	UG	G
Technology	21 (7)	21 (7)	24	18	22	20
No technology	18 (6)	21 (7)	21	18	16	23
TOTAL	39 (13)	42 (14)	45	36	38	43

Table 1. Need for Closure, Gender, and Academic Status of Subjects.

The treatments for GSS groups were administered in a univeresity computer research laboratory environment. The treatments for manual groups were administered in a nearby seminar room where group members were seated at a conference table. A different facilitator was used for both groups; however the facilitation was purely procedural and tightly scripted to ensure consistency.

Treatments

High and low evaluation apprehension were used to operationalize need to delay (NTD) vs. need to expedite (NTE) closure respectively (Mayseless & Kruglanski, 1987). NTD closure subjects were informed that their prioritized solutions to a case study problem would be evaluated for quality by a panel of expert judges and there would be penalties for ineffective solutions. This constituted the high evaluation apprehension treatment emphasizing the high cost of judgmental invalidity. NTE subjects were informed that their responses would be reviewed by a panel of experts but there would be no penalty based on solution quality. This constituted the low evaluation apprehension treatment, encouraging quality work but emphasizing no adverse consequences from judgmental invalidity. The treatments were similar in both phases of this research.

The Experimental Task

"The Case of the Unhealthy Hospital" (Kovner, 1991), a case study widely used in management education, was slightly modified as the task in this study. The case describes the hospital CEO's dilemma; charged with putting the hospital's financial house in order, he is faced with a complex set of problems and surrounded by advisors with conflicting interests and opinions. Groups were instructed to recommend two solutions to the hospital CEO.

Measures

NTE closure and NTD closure were the independent variables. Confidence and satisfaction with the decision were the dependent variables. Both were measured at the member-level, from member responses to relevant items in a post-session survey. All lists of brainstormed ideas were collected for analysis.

Procedures

All groups used the generate-evaluate-select process model during the session. A facilitator asked group members to read the task instructions and the task case study. Following a 15-minute period for reading the case study, subjects individually generated solution ideas and all ideas were recorded. Manual groups used the "tablet method" to generate solutions; i.e. jotting a solution on a tablet, returning the tablet to a designated "tablet area" on the table and picking up another tablet to record another idea. The tablet method was used to facilitate the exchange of ideas in an attempt to parallel the "Brainwriting" module (VisionquestTM), the electronic brainstorming tool used by the GSS groups. They were then asked to work as a group to evaluate all ideas and select two prioritized solutions.

All groups were given five minutes for solution generation and 20 minutes for face-to-face discussion, solution evaluation, and prioritization of the two "best" ideas. For manual groups, the facilitator transcribed all solutions from tablets onto a flipchart. For GSS groups, solutions were captured via the Brainwriting module were projected on a public screen. For all groups, the facilitator modified, edited, or added to the public solutions list as directed by the group. Each total session took approximately 90 minutes.

At the end of the session, each subject completed a post-session survey that included five items from Green and Taber's (1980) solution satisfaction index, an instrument widely used in GSS research (e.g. Zigurs, DeSanctis, & Billingsley, 1991). Two of the five items (Q1 and Q2) measured member's confidence in and satisfaction with the decision respectively. Three items (Q3, Q4, Q5) tapped member commitment and input to, and sense of responsibility for, the correctness of the decision. Two additional items focused on session characteristics and member demographics.

Results

GSS and manual groups produced two datasets which were analyzed separately because of the minor modifications made to the procedures after completing the manual group experiment.

Hypothesis 1. Hypothesis 1, which asserted a positive correlation between decision confidence and decision satisfaction, was supported. The Pearson r for both treatment groups was significant at the .05 level (see Tables 2 and 3).

Variable	Coeff.	Std. Error	Std. Coeff.	Tolerance	T	P (2 tail)
Constant	1.557	1.317	0.000		1.183	0.244
Confidence	0.902	0.192	0.713	0.655	4.698	0.000*
Q1	0.055	0.110	-0.072	0.740	-0.503	0.618
Q2	0.102	0.226	-0.063	0.775	-0.454	0.653

Analysis of Variance

Source	Sum of Squares	DF	Mean Sq.	F-ratio	P
Regression	29.037	3	9.679	9.463	0.000*
Residual	38.868	38	1.023		

* significant at .05

DV: Decision Satisfaction; N=42; Mult.R: .654; Squared Mult.R: .428; Adj. Squared Mult.R: .382; Standard Error of Estimate: 1.011

Table 2. Results of Multiple Regression on Confidence and Satisfaction for GSS Groups.

Variable	Coeff.	Std. Error	Std. Coeff.	Tolerance	T	P (2 tail)
Constant	2.334	0.859	0.000		2.718	0.010
Confidence	0.417	0.208	0.381	0.577	2.026	0.05*
Q1	0.173	0.117	0.263	0.659	1.483	0.148
Q2	-0.012	0.147	-0.015	0.621	0.080	0.937

Analysis of Variance

Source	Sum of Squares	DF	Mean Sq.	F-ratio	P
Regression	20.934	3	6.978	5.025	0.006*
Residual	45.823	33	1.389		

* significant at .05

DV: Decision Satisfaction; N=39; Mult.R: .560; Squared Mult.R: .314; Adj. Squared Mult.R: .251; Standard Error of Estimate: 1.178

Table 3. Results of Multiple Regression on Confidence and Satisfaction for Manual Groups.

Correlations for NTD and NTE closure subjects by treatment group appears in Table 4. All correlations are significant at .05. These results suggest that (1) confidence and satisfaction are significantly correlated; (2) the correlation is sensitive to different conditions in that it appears to be stronger for need to delay than for need to expedite . The last finding is of particular interest considering that the need to delay closure treatment was operationalized through high (versus low) evaluation apprehension. The need to delay treatment, by heightening evaluation apprehension via the high cost of judgmental invalidity manipulation, makes the consequences of closure as an end state more salient. Such consequences may be in the positive or negative direction. It follows that the correlation between confidence and decision satisfaction should be even stronger under such conditions (relative to low evaluation apprehension conditions). These results provide strong support for Hypothesis 1.

Treatment	n	NTE Closure	NTD Closure
GSS	42	.62*	.87*
Manual	39	.38*	.64*

* significant at .05

Table 4. Correlations for Need to Expedite (NTE) and Need to Delay (NTD) Closure Subjects by Treatment Group

Hypothesis 2. Hypothesis 2 postulated that information processing variables will not predict decision satisfaction directly, but rather through closure. For GSS groups, closure was a significant predictor of decision satisfaction (see Table 5). On the post-session survey, Q1 ("We generated a relatively complete set of potential solutions") and Q2 ("We evaluated alternatives thoroughly before selecting a solution") were significant predictors of closure . It is notable that Q1 and Q2 show no association with decision satisfaction (p>.05). Together, closure, Q1 and Q2 explained 38% of the variance in decision satisfaction.

Variable	Coeff.	Std. Error	Std. Coeff.	Tolerance	T	P (2 tail)
Constant	1.613	1.068	0.000		1.511	0.139
Q1	0.236	0.084	0.387	0.891	2.823	0.007*
Q2	0.425	0.176	0.332	0.891	2.419	0.020*

Analysis of Variance

Source	Sum of Squares	DF	Mean Sq.	F-ratio	P
Regression	14.636	2	7.318	10.278	0.000*
Residual	27.768	39	0.712		

* significant at .05

DV: Confidence; N=42; Mult.R: .588; Squared Mult.R: .345; Adj. Squared Mult.R: .312; Standard Error of Estimate: .844

Table 5. Results of Multiple Regression on Q1 and Q2 and Satisfaction for GSS Groups.

The results were similar for manual groups. Again, closure was a significant predictor of decision satisfaction (see Table 6). It is notable that Q1 and Q2 show no association with decision satisfaction. For manual groups, closure (Q1 and Q2 together) explained 25% of the variance in decision satisfaction.

Variable	Coeff.	Std. Error	Std. Coeff.	Tolerance	T	P (2 tail)
Constant	3.006	0.486	0.000		6.190	0.000
Q1	0.205	0.090	0.341	0.760	2.285	0.029*
Q2	0.302	0.110	0.412	0.760	2.758	0.009*

Analysis of Variance

Source	Sum of Squares	DF	Mean Sq.	F-ratio	P
Regression	23.577	2	11.789	12.487	0.000*
Residual	32.098	34	0.944		

* significant at .05

DV: Confidence; N=39; Mult.R: .651; Squared Mult.R: .423; Adj. Squared Mult.R: .390; Standard Error of Estimate: .972

Table 6. Results of Multiple Regression on Q1 and Q2 and Satisfaction for Manual Groups.

In summary, the results across GSS and manual groups were consistent with expectations; two information processing variables (Q1 and Q2) best predicted closure but not decision satisfaction. These two variables and closure together explained a significant portion of variance in decision satisfaction. No multicollinearity problems were detected in the analyses above. These results support Hypothesis 2.

An examination was conducted of the link between closure, decision satisfaction and three variables drawn from the Green & Taber's (1980) solution satisfaction index. These items were: "To what extent does the final solution reflect your inputs?" (Q3), "To what extent do you feel committed to the group solution?" (Q4), and "To what extent do you feel personally responsible for the correctness of the group solution? (Q5). For both GSS and manual groups, closure again was the single strongest predictor of decision satisfaction. Q3 and Q4 showed moderate association with closure, but not with the latter. These results indicate that, from among the post-session survey items, information processing variables (Q1 and Q2) were better predictors of closure than variables without an explicit information processing focus (Q3, Q4, and Q5). This is fully consistent with our predictions. These results are notable in that items from a widely-used scale show associations consistent with the model.

Analyses of Idea Solutions. Analyses of ideas generated by all groups were conducted. An initial count of individual's ideas indicated 29% more ideas were generated from subjects in the GSS groups than in the manual groups and that only in the GSS groups was there any difference in the number of ideas depending on need for closure (see Table 7), a phenomenon consistent with the literature (e.g. Benbasat & Nault, 1990).

Group	n	NTE Closure	NTD Closure	TOTAL
Manual	39	85 (50%)	85 (50%)	170
GSS	42	117 (53%)	103 (47%)	220
TOTAL	81	202 (52%)	188 (48%)	390

Table 7. Number of Individual Ideas and Percentage by Need for Expedite (NTE) and Need to Delay (NTD) Closure and Treatment Group

Raters were asked to categorize each brainstormed idea solution on the basis of whether it was (1) a single idea, (2) an "enriched" idea [a single idea with more breadth (multiple steps or parts) or depth (detailed explanation or clarification)] or (3) multiple ideas (more than one idea contained in a single thought). An example for each category taken from the data appears below in Figure 2.

Single Idea:

"Move all services from the clinics to the hospital except prenatal care and needle exchange."

Enriched Idea:

"Close off-site clinics and move all hospital staff back to hospital. then bus patients to the hospital. They could still see the staff they know/trust."

Multiple Ideas:

"Close down all off-site clinics. Set up a shuttle-bus service between the off-site clinics and the hospital. Use the money saved for city-wide advertising, new doctors & hospital improvements."

Figure 2. Examples of Single, Enriched, and Multiple Ideas.

Additional analyses were conducted on items upon which there was initial disagreement until consensus was reached. Preliminary results appear in Tables 8 and 9.

Treatment	n	Single	Enriched	Multiple
NTD Closure	42	64 (34%)	64 (34%)	60 (32%)
NTE Closure	39	76 (38%)	79 (39%)	47 (23%)

Table 8. Means and Percentages of Single, Enriched, and Multiple Ideas by Subjects with NTD and NTE Closure.

Group	n	Single	Enriched	Multiple
Manual	39	38 (22%)	68 (40%)	64 (38%)
GSS	42	102 (46%)	75 (34%)	43 (20%)

Table 9. Means and Percentages of Single, Enriched, and Multiple Ideas by Subjects in Manual and GSS Treatment Groups

Results indicate that 29% more total ideas were generated from GSS groups. GSS groups had more single and enriched ideas than manual groups but fewer multiple ideas than manual groups. It is possible that if the multiple ideas were teased apart, the results might indicate that manual subjects had as many or even more ideas than GSS subjects. Furthermore NTE closure subjects generated more single and enriched ideas but not multiple ideas than NTD closure subjects. The need to expedite GSS group generated the fewest number of multiple idea solutions. While it is reasonable that the GSS groups would generate a larger number of single ideas because the technology provides limited space for responses, this theory breaks down when comparing the number of enriched and multiple ideas which appear to require equivalent "space" for responding. Further analyses are needed to help explain these results.

In summary, in this research we advanced an operational definition of closure and explored the relationship between confidence (as a cognitive belief preceding closure) and satisfaction in group decision making using GSS and manual methods in an experimental setting. A theoretic, cognitive-motivational framework was used to conceptualize the constructs of interest in a closure model of decision satisfaction. The results, which were consistent with expectations based on the model, suggest that (1) confidence and decision satisfaction are significantly correlated, and (2) information processing variables are significant predictors of confidence, but not of decision satisfaction. Together, confidence and two information processing variables explained a signficant proportion of the variance in decision satisfaction.

Discussion

The Cognitive-Motivational Model of Group Member Decision Satisfaction characterizes the decision-maker as an active evaluator of the adequacy of the "epistemic" process. Need for closure influences adequacy assessment. Information processing deemed extensive in need to expedite conditions may be deemed inadequate in need to delay closure conditions, suggesting that the uncertainty cutoff may be set relatively low in need to expedite conditions and relatively high in need to delay closure conditions.

This model suggests a number of relevant areas for future research on satisfaction and the use of technology support systems for enhancing satisfaction with group work and further development of our model. One promising area is satisfaction as a criterion for assessing other motivation variables. For example, Rotto (1994) and Arnone & Small (1995) posit a relationship between satisfaction and curiosity. Individual differences (e.g.trait curiosity, impulsivity, tolerance for ambiguity) may influence need for closure and, therefore, should be explored. Furthermore, this study explored how potential negative consequences (punishment) affected extent of information processing; but would there be similar results with potential positive consequences (reward)?

Research is needed to investigate group member attitudes (Hooper et al. 1994). Informal discussions with some subjects indicated annoyance with attitudes of some team members (e.g. dominating, lack of empathy). The impact of group dynamics and interactions and of ad hoc groups vs. established teams on confidence and satisfaction are potentially important areas for additional study.

Computers also facilitate feedback and group interaction. Although the current model does not incorporate a feedback component, adding appropriate feedback loops to the model may increase the likelihood of confidence and satisfaction in group work. This is another area for future work.

Although this research examines decision satisfaction, it might be interesting to explore the relationship between closure and process satisfaction. If need for structure is functionally equivalent to need for closure (Mayseless & Kruglanski, 1987), then interventions emphasizing process structure may promote process satisfaction.

Because of their ability to organize and quickly retrieve data, computers are believed to hold great promise for creating environments for developing and enhancing problem-solving and decision-making skills (Duffield, 1994; Flake et al., 1985; Thornburg, 1986). The study of satisfaction may also have direct implications for group work and the development of computer-based systems that support group problem-solving and decision-making in learning contexts.

King & King (1993) describe a study exploring the transfer of decision-making skills to a computer-simulated environment intended to help young students working in pairs to reduce impulsivity in decision-making situations and make more thoughtful decisions. They found instead that in the computer-simulated environment there was a significant increase in impuslivity; i.e. decision making by one partner with no discussion or input from the other.

They suggest that one reason this might have occurred due to their pretest session experience with the game "which could have provided them with a greater degree of confidence to make decisions without their partner's help" (p. 60). They attribute much of the impuslivity to the effects of computer games which require immediate decisions in order to avoid the penalties imposed. They suggest a "braking device" to slow down the decision-making process and the addition of explicit prompts to cause students to be more reflective. The authors suggest that the decision-making process is more than a cognitive activity but that it also incorporates other aspects of an individual, including affect.

Klein & Pridemore (1992) advocate future research that explores the use of technology in group learning situations as well as performance and motivational outcomes in group work. Research that explores both the cognitive and affective aspects of higher order thinking skills such as problem-solving and decision-making will contribute to the development of computer-based systems that enhance those skills.

Computer systems are needed that go beyond merely displaying generated ideas to visually mapping the ideas so that users can see interrelationships among them and judge their characteristics such as depth, relevance, and usefulness of individual solutions. In addition, Steeb and Johnston (1981) suggest that visual aid organizers may help decision-makers deal with information overload more effectively.

Exploration of applications of GSS technology in education may have particular implications for instruction using case studies (e.g. management education). Case study analysis lends itself well to investigation of group member satisfaction since it often involves group analysis and judgment formation.The case study method involves analyzing and processing complex information, generating plausible alternative problem solutions, and making decisions (Hudspeth & Knirk, 1989; Hammond, 1980; Sulkin, 1966).

This line of research may also provide support for the need to teach information skills. For example, Sieber & Solomon (1970) and Lanzetta, (e.g. 1963) assert that teaching students skills such as cue discrimination, hypothesis generation and hypothesis evaluation and information skills such as filtering irrelevant from relevant information will lead to greater information search behavior and decrease uncertainty.

Finally, an analysis of ideas generated looked at quantity of ideas by treatment groups and use of GSS or manual methods. Future research will include analysis of the quality of ideas generated.

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Title:

An Essay on Experience, Information, and Instruction

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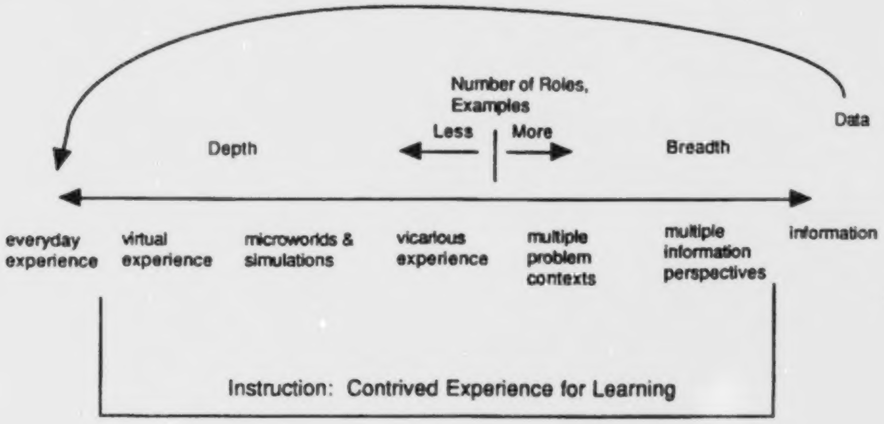
About ten years ago Nolan Bushnell, the founder of Atari and microelectronics pioneer, was the keynote speaker for AECT. One striking picture that Bushnell portrayed of educational technology in the future is the ability through virtual reality to come close to first hand experience of any event or place. Instead of reading about Italy, a student will be able to walk down the streets of Italy where (s)he wishes to go, smelling the smells, feeling the sunshine. Instead of reading, hearing about, or passively watching a reenactment of the "Boston Tea Party" students could actually "participate" in it, hacking open barrels of tea and tossing them into the Boston Harbor. Being true fans of the "Star Trek Next Generation" *holodeck* we have been enchanted by the educational future that Bushel presented. At the same time, as educational technologists, instructional designers, learners, and tax-payers, we were immediately both struck by the effort involved in such virtual experiences and by the uncertainty of when such experiences would be so desirable that the costs would be worthwhile. We have also conjectured about if or when such experiences might actually be deleterious to learning. Although these issues do not "map" directly upon the issues of situated cognition, they are related to some of the recurring issues addressed by instructional designers and instructional theorists regarding the role and nature of experience in learning.

Recent developments in microelectronic technology have made substantial changes on how experience and information are perceived. These changes have also contributed to a major shift in how instruction is perceived. Instructional technologists must keep abreast of not only the product technology developments and their impact on popular culture but also, and perhaps most importantly, the implications and repercussions for instructional technology. It is easy to become swept up in the flow of the more widely-held popular interpretations of "technology," loosing both traditional strengths and intellectual leadership so desperately needed in times of change. In this paper we will consider the relative cognitive requirements and benefits of learning from non-contrived experience and information presentation, and contrast these advantages and costs with contrived experience and information-reduction that are features of instruction.

In our reflecting on these issues we have constructed one perspective of how experience and information relate to each other and to instruction. We later in this paper will discuss these terms but here we will overview one way of viewing these relationships that may be productive for instructional technologists. The dimension represented on the continuum is abstraction of experience. In "everyday experience" the only abstraction that occurs, is that which the individual performs on the raw stimulus data. On the other end, information is data that has been reduced and organized by the author in order to represent his or her personally relevant interpretation of multiple events, objects, and experiences.

Figure 1. Experience to information continuum.


Number of Roles,
Examples
Less
More
Depth
Breadth
Data
everyday experience
virtual experience
microworlds & simulations
vicarious experience
multiple problem contexts
multiple information perspectives
information
Instruction: Contrived Experience for Learning

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Experience

Recent developments, and much-discussed pending ones, in computer technology are changing what a person can anticipate in the way of feasible experiences. Increasing precision and realism of available computer-driven simulations now provide "experience" in flying private aircraft, WW-I biplanes, WW-2 fighter aircraft, F-18 "Tomcat" and other current supersonic military aircraft, in either cross-country flight or in combat with other aircraft. These simulations are available to anyone with a personal computer and $29 for the purchase price of the software. At lower levels of fidelity, these and other real-time simulations were available 15 years ago for use on Apple II computers: This technology can no longer be considered new. "Artificial experience," whether represented by aircraft simulators, chess players, city-building, skiing, golfing on the 12 best courses in the word, or engaging in a worldwide search for a master criminal has been with us long enough to soak into the popular culture.

Virtual reality is another, related development that extends technology's impact on what we may experience. Virtual reality maximizes sensory involvement in increasingly realistic and compelling simulation-like interactive environments, allowing a participant to, in the words of Nolan Bushel (1986), "be there." In the glow of fascination with the ability to supply such experience through technology, the technoromantic often forgets that to experience everything first hand takes too long. We often read about or engage in other abstractions to save time: there is not time enough to experience it all firsthand.

The cognitive operation of forming concepts is a means of protecting us from experiencing everything directly. Once a person knows "chair-ness," the experience of seeing a chair never seen before looses some of its luster. The jaded chair-knower can go about in a world filled with countless kinds of chairs with hardly a second thought to each new chair, except to be sure it is in the right place before sitting down. There is a fundamental trade-off at work: we trade off the joy of experiencing a new world filled with new wonders at every turn for the power and efficiency that knowledge of the world gives us.

Analogous to forming concepts, the phenomena of written and uttered language of all sorts-- verbal, mathematical, musical, visual -- allows condensation and distillation of direct experience. Most of the operations allowed by language systems can be performed without them, but at impossible expense in time requirements. It is perhaps most fundamentally the time problem that makes it ludicrous to imagine a reform in human interactions, activity, and learning that would be based on the elimination of all things not part of direct experience.

Altering availability and quality of experience through technology is not a particularly new thing. In the 1930's and 40's, the progressivist movement sought to improve education through a greater concentration on student's experiences. Dewey's work on the role of experience in learning (1919, 1938) forms the philosophical basis for much current thinking in experience-centered learning.

Dewey's thinking was not directed at instruction, per se, but was a broader conceptualization of education as an enterprise to serve democracy. Yet, his insistence on the requirement of education to be built from and serve the needs of individuals as opposed to external, traditional academic sources, is a thread that runs through current educational thought. Dewey's thinking on experience was not merely based on the need for relevance but also in a fundamental sense, tied closely to a rational, reflective thinking pattern or "scientific method," citing that method as "the only authentic means at our command for getting at the significance of the everyday experiences in the world in which we live." (Dewey, 1929)

Instructional technology provides us with a changing conception of the role of experience. A long-standing orientation of many classroom teachers, against which instructional technologists have struggled for many years, has been the planning and provision classroom experiences without sufficient attention to what sorts of learning those experiences might lead to. An instructional design orientation to improving teaching has suggested reevaluating an "activity for activity's sake" orientation to teaching. Instructional designers have suggested rather than teachers and curriculum developers consider the potential outcomes of traditional activities. In contrast, current thought as embodied in the constructivist movement sometimes emphasizes richness of experience as an end in itself. According to some theorists, experience has become the objective for constructivists. Learning is said to be in the experience, not a product of the experience. How we come to know is seen to be in our interactions with the environment, not a product of those interactions (Duffy, 1994).

We concur with the important contribution to the quality of learning that situated cognition, authentic tasks, and other constructivist tenets can bring to learning from instruction. There have been countless instances of learners suffering from "un-authentic" instruction that leaves the learner with no internalized, meaningful body of knowledge or skill. Such appears to be the case with much of mathematics learning in the United States today. It seems clear that there is a critical need for tools that will help learning become meaningful, and it appears that situated cognition and other constructivist tools represent true progress in this direction.

The difficulty we face is a lack of sufficient work on when, and under what circumstances these tools or approaches should be used. Some alternative conceptualizations could be explored:

1) Approach all instruction from either extreme, only information, always direct, everyday experience. We reject this alternative out of consideration for the requirements imposed by certain interactions of learners, learning tasks, and often other factors from instructional needs, settings and the like. Other considerations may also tip the choice, including those for need for efficiency of learning that may override needs for meaningfulness and interest. Medical schools may choose not to break each bone in the bodies of students who are specializing in orthopedic surgery. Or, as Winn has noted: "I am not convinced yet that all knowledge can be constructed by students. The student must have some knowledge from which to start instruction, and that knowledge must be explicitly taught." Winn (1992)

2) Never acknowledge one of the extremes as a means to learning. We reject this alternative based on consideration of the unquestionable value of direct experience and raw information to learning. However, we would not term these extremes "instruction."

3) Sometimes use experience-rich or information-rich strategies, depending on the situation. This is the position we wish to work from, leaving the question, what would guide us in deciding when and under what circumstances will working at the extremes be useful? The task, it seems to us, is to learn more about what interacts with situations and instructional strategies.

Information

Popularly available information in recent years has changed from static to dynamic, from carefully gatekept to open, from delayed to immediate, and from structured to free-form. We see this information resident in hypermedia, databases, computer networks and bulletin boards, and in information storage media, such as CD ROM technology. This information can be timely, provide contrasting perspectives, and provide extreme depth and detail in coverage. To those having strong information needs, never has information been so rapidly available.

Exploration in information-rich, hypermedia environments has been seen by some as a solution to educational problems. However, provision of access to information, regardless of how deep or elaborate, is not in and of itself sufficient for instruction. All of the issues that the constructivist movement has so forcefully put are germane: meaning does not reside in the message, ideas are not "transferred," individuals must organize or "construct" information in ways that are personally meaningful. This task can be overwhelming when working from an information-only base, or as Perkins described it, having a "high price in the cognitive economy" (1992).

Some research seems to support the suggestion that pure information may not be sufficient to support learning. For example, Jacobson, Kolar, Maouri, Mishra and Spiro (1994) investigated learning in hypertext environments and found that learners in a no-guidance condition were overwhelmed and not as successful as learners provided with guidance. "The mere availability of nonlinear hypertext links may not be sufficient to affect substantive learning outcomes." (p. 17)

Some limitations inherent to information-based learning systems include the expectations of learners' abilities to select, evaluate, sequence, and structure this information anticipates new levels of text processing and other learner strategies that may not be presently available in many learners' repertoire. Other characteristics possessed by novices in a domain severely limit the usefulness of unguided exploration in information bases.

Instruction

The technology of printing reduced demands on learners from that of direct experience or the vicissitudes of oral tradition, and the technology of instruction/teaching has offered a guiding hand through the world of information. The term, "instruction," never well-understood, seems to be taking a new meaning, one that is far from its rich meaning in the context of instructional technology. A frequently-observed trend is to consider instruction as referring to only a specific sort of strategies, ones of a didactic or reception-learning sort. By some, instruction is perceived as something "done" to learners, rather than something that is "participated in" by learners. We consider instruction to include a range of strategies that facilitate experiences that are expected to lead to learning.

Instruction may be seen to reside between two poles: experience and information, and should involve a process that involves both sources of learning, as the situation requires. On the continuum presented earlier, we place instruction in the range between everyday experience and transmission of information. Indeed, we describe instruction in this arena, to be the facilitation of contrived experiences. These contrived experiences can range from "being there" as in participating in the Boston Tea Party to selecting and reading excerpts of diaries of British and colonial participants and observers of the Boston Tea Party, to reading historical analyses of this event and evaluating or reacting to them.

Instruction that is all experience is at risk of being vapid and impractical, or too limited in scope or example-provision to allow transfer. Instruction that is all information may be irrelevant and meaningless. Choices between the two sources as well as other essential ones in fostering learning are implicit in instructional design. The richness of experience and information that computer-based learning environments can now provide is seductive in appearing sufficient to learning, in much the same way that motion picture films were seductive to educators of the 1920's and 30's. Fascination with the power of a technology should not distract us from learning to harness the technology for learning rather than worship it. Critical in these instructional decisions are evaluating the nature of the learners' prior knowledge, motivations, beliefs, as well as the nature of the potential learning outcomes.

A question, illustrative of our concern, is what forms of learning guidance are needed in exploratory learning situations. We are currently engaged in empirical studies on this topic, in which varying forms of support are employed in exploratory, computer based learning environments. Our preliminary results are pointing to a particular needs for support for novice learners, different from the needs of learners with prior knowledge or skill.

In an article on conditions that foster student engagement in productive autonomous learning activities, Thomas and Rower (1993) provide a set of course-specific facilitators including the explicit articulation of demand conditions and support practices, the provision of authentic self-directed learning responsibilities and tasks, and opportunities to assess the effectiveness of existing strategies and to learn new ones.

Often the provision of the paired situations, as exemplified in the Jasper series (such as Journey Down Cedar Creek), while rich and engaging, fails to provide application of skills in more than one context, decreasing the odds of transfer. We would not avoid the Journey Down Cedar Creek (though a question exists as to how "authentic" a situation a boat trip might be to many learners, such as those from inner city environments), but would question its adequacy, hoping to extend it with practice using multiple examples.

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Title:

User-Centered Innovation: A Model for *Early Usability Testing*

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The overall goal of this study is to show how some concepts and techniques from disciplines outside Instructional Systems Development (ISD) have the potential to extend and enhance the traditional view of ISD practice when they are employed very early in the ISD process. The concepts and techniques we employed were user-centered design and usability, and the context of our study was an instructional development project in the earliest stages of design.

What are user-centered design and usability?

We will define user-centered design as a philosophy that places the eventual user of a product at the heart of the design process for that product. Usability is a key concept within the philosophy, and refers to the cluster of attributes commonly considered to determine the ease-of-use a product will enjoy; learnability, efficiency, memorability, error prevention and recovery, and user satisfaction (Nielsen, 1993). The terms are sometimes used interchangeably, and both are used frequently to distinguish product development methods and processes that facilitate the creation of usable computer products (Strong, 1995). The methods and processes associated with user-centered design are derived from multiple disciplines including, among others, human factors, ergonomics, psychology, ethnographic studies, and document design.

One of the fundamental principles of user-centered design is that users must be involved in design decisions for the products they will use. From this principle is derived an iterative approach to design, since the input of users forces designers to reconsider their own decisions and assumptions during the development process. Furthermore, the iterative approach demands use of rapid prototyping techniques to make testable products available early enough in the process that they may be altered, sometimes repeatedly, before they are delivered in final form.

Applying user-centered design and usability to instructional product development

A variety of principles and methods associated with user-centered design appear to overlap in part with elements of the instructional development process, specifically needs analysis, audience or learner analysis, and formative evaluation (Dick & Carey, 1990), but there are not direct equivalents for usability evaluations within standard ISD. Tripp and Bichelemeyer (1989) propose that rapid prototyping and testing techniques from user-centered design can be best applied in: 1) novel designs: those products that are new and/or; 2) problematic designs: those designs that present problems to the development team that have not been successfully solved previously. We chose the Indiana University Center for Excellence in Education's (CEE) *Virtual Textbook* project as a viable candidate for application of usability evaluation methodology to the development of an instructional product.

Applying user-centered design to the concept of an interactive whiteboard

The *Virtual Textbook* project, still in early design stages is defined by its developers as a "single integrated delivery environment" for "a new form of interactive learning" (Siegel, 1992). One component of the virtual textbook is the interactive whiteboard which the designers envision that students will use during groupwork activities. As it is conceptualized, students would transmit text and pictures, among other things, through their virtual textbooks onto the whiteboard and share these items with other members of their group.

There have been some references to interactive whiteboard technology in corporate settings (e.g., Weiser, 1991), but we have found no published studies on incorporating an interactive whiteboard in educational settings; hence, the interactive whiteboard is a novel design problem for this team. Consideration of the interactive whiteboard raises specific issues for the design team, for example, once an item is on the whiteboard, will it be owned by the group or by the original student? The team also faces a larger question: how should the interface between the virtual textbook and the interactive whiteboard be designed? We decided to focus on the issues surrounding the interactive whiteboard for our usability study.

Our major goal for the interactive whiteboard study was to understand how representative virtual textbook users, high school students, would interact with an interactive whiteboard with the fewest possible imposed restrictions of an established interface. We chose to simulate the interactive whiteboard, since use of the commercially-available model would require us to conform to an established interface. To simulate the interactivity of a whiteboard, we used volunteers who put up and took down pictures and text from a regular blackboard in response to students' requests. Students participating in the study were told to direct their requests to the whiteboard instead of the volunteer, and given only minimal instruction on formulating those requests.

We videotaped five groups of either three or four students as they constructed a timeline depicting the history of rock and roll music, an activity that teachers told us was representative of groupwork projects, but which did not overlap with any current projects for these students. Each student was given twenty items, both pictures of rock and roll musicians and text descriptions of these musicians, and the group was given guidelines for the construction of their timeline which they completed during two half-hour sessions. Since the goal of the usability sessions concentrated on the interactions of students with the simulated technology we did not focus on the timeline produced by each group, but on their interactions with the simulated whiteboard. Sugar and Boling (in press) give more detail on the sessions themselves.

Results of usability sessions

There were two major results from these early usability sessions: findings from the sessions and results from discussions with designers. The findings from the sessions are grouped into strategies/tactics and social issues. We presented the findings to the *Virtual Textbook* designers along with several of the usability session videotapes and recorded their reactions. The designer's reactions fell into four categories, 1) proposing new and revised features, 2) reconsidering assumptions about students using the whiteboard, 3) questioning the design of the usability sessions, and 4) posing questions to be answered in future usability sessions

Findings from the usability sessions

After viewing each videotaped session, we identified two major categories of student collaborative interactions, namely: 1) strategies/tactics; 2) social aspects. Each student group employed common strategies and tactics during both sessions. Students used these strategies and tactics to manipulate either a picture or text item on the simulated shared space. In addition to these manipulations, each group expressed similar social characteristics in order to manage and complete the rock and roll music timeline. Below, we have described common occurrences in both these categories.

Strategies/tactics

- *Types of moves*: There were three primary moves that the student groups performed: singular moves, combination moves (e.g., "Put The Beatles at 1969 and take Jerry Lee Lewis down"), and simultaneous moves (those moves that were voiced by more than one subject).

- *Command language*: Each student group use a similar command language pattern in communicating to the shared space. In the beginning of the task, students constructed their commands with a "verb/subject" format (e.g., "Put Chuck Berry in 1950"). Students gradually deleted the verb from the command format and referred to the material by the subject (e.g., "Chuck Berry in 1950"). When student groups were involved with task and not cognizant of communicating formally with the shared space, they relied on using jargon to communicate with the shared space. Examples of these type of jargon included such statements as: "*Slap on* The Byrds close to 1963" or "*Call up* Prince".

- *Students' language*: During group discussions, the volunteer simulating the interactive whiteboard could not always tell whether students wanted to put an item on the board. One student would say that they should put an item up, but another student would disagree, and the language they employed might or might not be construed as direct commands to the interface.

- *Shared space maintenance*: Since the student groups only had a limited amount of space (a maximum of 21 items), the groups eventually confronted the issuing of "cleaning up" or maintaining the shared space. The two groups employed two major strategies in dealing with this issue. Some student groups issued global commands; for example, one group asked to take *all* of the text items off the shared space (e.g., "Take all of the written statements down"). Another major strategy was to designate a certain portion of the shared space to review items.

- *Item maintenance:* Each student group employed common tactics in maintaining their work space. There was an apparent need to sort through their items on their desks. Students would sift their items to figure out which items to include on the timeline; they would put used items in a separate pile. This finding and the previous one indicate a need for a workspace to view several items. This proposed workspace could be located on student's individual virtual textbook or on the common shared space.

- *Shared space navigation*: Before students would put up a item, they checked the whiteboard. There was a constant interplay of students checking the board, their respective piles of pictures and text, checking the board again, and then deciding which item needed to be on the board. Students also needed to figure out a specific location to put their items on the shared space. Students either referred to a specific year on the timeline or referred to a existing item on the whiteboard near which to place pictures or text.

Social aspects

- *Common ownership*: A major question prior to this study was whether students had common ownership of the materials that were held in shared space. That is, if one student put up his or her picture in the shared space, would another student freely move or take down that student's picture? Overwhelmingly, each student group treated the shared space material as common property. Students moved other students' materials to other locations in the shared space and deleted those materials off the board. When there was a disagreement on the transfer or removal of a certain item, it was settled by the dominant group members in that student group, not the original "owner" of the picture or text.

- *Turn-taking*: We expected to see students establish a set of rules on how to take turns in communicating with the shared space. It appears that there were usually one to two dominant students who acted as "gatekeepers" or spokespersons for each student group. These students would direct other students moves. They would either approve or veto the group's decisions. This transfer of power originated from students' need to confirm decisions among group members before putting items on the board. These decisions were mediated through these dominant student(s).

- *Strategy discussions*: After the initial period of putting items on the board, students usually discussed on strategies on how to complete the timeline. These discussions focused on particular pictures (e.g., "who has Jimi Hendrix?") and where to place items (e.g., "where should we put Bob Dylan?").

- *Limited collaborative skills?* The student groups understood their task to be a cooperative one, since they were told that they each had part of the materials required to complete the timeline, and no one of them had everything required. However, none of the groups was observed to organize themselves in preparation for the work, choose a leader (although dominant members emerged in each group), settled on or even discuss a process for their work, or carry out any coherent effort to plan the task. Various groups were observed to spend time ineffectively, marginalize one or more members who were later discovered to have information needed by the group, and backtrack through actions due to misunderstandings.

- *Need to consult at close range?*: Even though there was a restriction on sharing items among themselves (in order to maximize observed interactions with the whiteboard, and to simulate the probability that virtual textbook screens might not be large enough to use for this kind of consultation) and groups were reminded of the restriction, students consistently consulted with each other by holding up and passing around pictures and text items.

Results from discussions with *Virtual Textbook* designers

The virtual textbook designers had four major types of reactions to our presentation of these findings and their viewing of videotaped sessions; 1) proposing new and revised features, 2) reconsidering assumptions about students using the whiteboard, 3) questioning the design of the usability sessions, and 4) posing questions to be answered in future usability sessions. We believe these reactions gives insight into the potential impact of the usability sessions on the process of designing instructional products and the possible impact of user-centered design on the instructional systems design (ISD) process.

- *Proposing new and revised features for the whiteboard*: The designers had envisioned the functionality of the interactive whiteboard within the virtual textbook environment to the extent of representing some of its major features in a "conceptual video" mock-up, but once they were presented with findings of the usability sessions and the videotapes, they began to speculate on both new and dramatically revised features the whiteboard might have. Among other things, they discussed the development of a new command set within whiteboard interface, and designing a horizontal whiteboard instead of a vertical one.

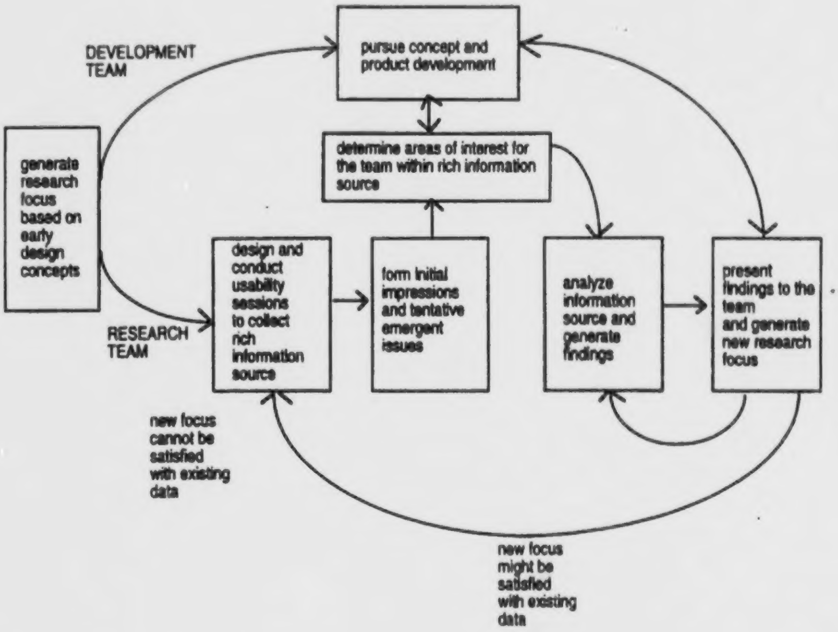
- *Reconsidering assumptions about students using the whiteboard*: The designers showed considerable interest in the findings concerning strategies/tactics and social aspects described in the preceding section and spent time discussing how to redesign and reconceptualize the interactive whiteboard in response to this more detailed view of the students who would use the technology. Should the whiteboard interface try to compensate for limited collaborative skills? If so, how? Should the whiteboard interface encourage or discourage the "gatekeeper" function observed in every group?

- *Questioning sessions' design*: The designers wondered whether students were comfortable with addressing the "simulated" whiteboard and suggested that future usability sessions should focus on students groups working without an interactive whiteboard to answer some of their new questions about how students work together and to limit the admittedly confounding effect of the simulated technology. The designers were enthusiastic about the possibility of conducting further usability sessions, in spite of their questions about the design of this one.

- *Posing questions to be answered in future usability sessions*: The designers posed a variety of questions they wanted answered through future studies: do students need to touch their documents rather than indirectly manipulating them? how should students cue their commands with the interface? what type of order needs to be imposed with a common work space? will the same social dynamics occur among students if the usability sessions were altered? what impact is the whiteboard technology having with the social dynamics? Though there were no conclusions among designers about the design of the *Virtual Textbook* interactive whiteboard interface, there was tremendous amount of creativity exhibited by the design team during the discussions of these usability sessions.

Early usability testing model

The model represented in this paper describes how we conducted usability tests in relation to the design and development work ongoing in the *Virtual Textbook* project. Although our study used two separate teams to conduct tests and carry out ongoing development, the model could as easily describe parallel activities by members of a single team. The model cycles back into itself, demonstrating the difference between usability studies and experimental research; the focus of usability studies is contained within a project and the results of the studies guide further design efforts. There is no expectation that findings from these studies will generalize outside the project for which they are conducted, although they may be of great interest to designers working on similar projects.


DEVELOPMENT TEAM
pursue concept and product development
generate research focus based on early design concepts
determine areas of interest for the team within rich information source
RESEARCH TEAM
design and conduct usability sessions to collect rich information source
form initial impressions and tentative emergent issues
analyze information source and generate findings
present findings to the team and generate new research focus
new focus cannot be satisfied with existing data
new focus might be satisfied with existing data

Some anticipated criticism of the *early usability testing* model is that this testing is simply formative evaluation. Tessmer (1993) points that the rapid prototyping technique is similar to "repeated formative evaluations." Although the evaluation techniques are similar in usability testing and traditional formative evaluation, the key difference between the two is how early in the process and how often a product is evaluated. In describing the rapid prototyping techniques of his ID2 theory, Merrill and his associates comment that the instructional systems development (ISD) approach assumes that there will be no actual product until the later stages of the process (Jones, et al, 1992). The *early usability testing* model provides designers the opportunity to assess and evaluate their concepts and assumptions during the earliest stages of a design. The model also presumes that the evaluation process will be carried out several times during the development process, giving designers the opportunity to adjust designs in situations where they have little prior experience to gauge the probable success of a product.

Implications for the ISD process

What impact does this model have for the ISD process? In our experience with this study, *early usability testing* may impact the ISD process in four ways; 1) condense ISD process; 2) refine prescriptive methods; 3) encourage a cyclical process; and 4) concentrate attention on the human elements of the process.

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- *Condenses ISD process*: The results of user-centered design evaluations provide insight for the next analysis phase, and can give rise early in the process to questions that might not otherwise be asked until a product is almost ready to be implemented. Catching and considering a wider range of issues for design at the beginning of a project may reduce overall development time, especially in cases of novel or problematic technology.

- *Refines prescriptive methods*: *Early usability testing* also gives instructional designers the opportunity to test the prescriptive methods they are encouraged to develop by Reigeluth (1983). Through each redesign phase of the *early usability testing* model, designers can refine these methods with the goal of having the most effective methods for their final product. We would assert that refined methods developed using an *early usability testing* model must be more effective than prescribed methods tested only once under a traditional ISD model.

- *Encourages a cyclical process*: Dumas and Redish (1993) differentiate between two types of process models: *assembly line* and *cyclical team* models. In the assembly line process, designers develop their products in successive and separate phases. There is a dearth of feedback between each of the phases. An example of this model is where a design team develops a product during the development phase, and then, the marketing department (a different set of individuals) evaluates the same product. There is limited communication between these two groups and thus, assumptions and realizations of the design team are *not* communicated to the marketing department. In contrast, the cyclical team process, a design team performs each step of the design process (e.g., analysis, development, evaluation). The assumptions and realizations of the design are fully communicated to each member on the design team. The *early usability testing* model is explicitly cyclical, encouraging both communication between all team members and re-examination of prior decisions on each repetition of the cycle. We are *not* suggesting that all instructional designers who follow the traditional ISD process are using an assembly line process. However, the traditional ISD model presents cyclical development as a desirable option, not as a requirement.

- *Concentrates on the human element in the process: Early usability testing* seems to give the eventual user of an instructional product a consistent "presence" within the development process. Once designers have observed real people use even an approximation of their product at the earliest stages of conception, they tend to refer back to those people throughout the project to visualize the effect that future design changes might have on them.

Conclusion

Our study has only touched the surface of the issues, and we know that some of the controversies that attend user-centered design accompany its introduction into ISD, for example, the question of cost/benefit analysis for the additional effort spent conducting usability sessions and debates over specific methodological applications for one type of project and another. However, our experience suggests that the possibilities for incorporating user-centered design concepts, and specifically usability testing, in the ISD process deserve consideration and further study.

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Title:

World Forum Communications: Analyses of Student and Mentor Interactions

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Abstract

This study analyzed new forms of student social interaction and dialogue within asynchronous communications of six middle schools and six high school participating in the World Forum. In the World Forum, students discussed, questioned, and debated with Arctic explorers, researchers, World Forum mentors, and peers about environmental issues. One of the three key tasks, Flash Points, generated more lengthy dialogue than other techniques (i.e., Arctic Alerts and Questions to Explorers). Analysis of the forms of assistance provided students indicated that mentor interactions with students was mainly to provide feedback, question, and cognitively structure the lesson or activity; minimal instruction or modeling of how to interact occurred. Few student questions about environmental issues or exploratory activities were of an evaluative or analytical nature, but, instead, most were fact or knowledge-based. Despite the minimal assistance and the low-level of questioning, student role taking activities within their environmental discussions (here, students assumed roles of famous people like Professor Stephen Jay Gould and Mr. Richard Leakey) enhanced the degree of perspective taking in their conversations. Examining the interaction patterns, forms of mentor assistance, level of questioning, and degree of perspective taking provided new insights into the impact of electronic communication on student learning, but additional assessment techniques are still needed.

Introduction

As society rides the crest of the Information Age wave, futuristic predictions become pedestrian (Naisbitt, 1984; Schrage, 1990; Toffler, 1980). In theory, students and teachers soon will have access to "the best" information regardless of "geography, distance, resources, or disability." At the same time as these new technologies advance opportunities for student-student distance collaboration and dialogue, many educators are turning to sociocultural theories like Vygotsky's (1986) to analyze learning in a social context (Tharp & Gallimore, 1990; Wells, 1994). Disappointed with learning theories that advocate discrete or inert knowledge, research on the social context of learning lends support to a more learner-centered school pedagogy (Alexander & Murphy, 1994; The Cognition and Technology Group at Vanderbilt, 1991; Duffy & Jonassen, 1991; Tharp, 1993). The collaboration, negotiation, questioning, and scaffolding of more "active" learning environments is drawing attention to this movement.

This study offers one glimpse of what how these trends in technology and learning theory might be married. Tools for writing and conversation, for instance, are elevating many school activities from silent, solitary acts, to one's rich in student discussion, dialogue, and debate (Bonk, Medury, & Reynolds, 1994). However, researchers have yet to make significant progress regarding how cognitive processes displayed on a social plane such as electronic mail and dialogue eventually become internalized by the participants as independent problem solving skill (Wertsch, 1985). Before sociocultural ideas can impact educational reform, new approaches are needed to observe and measure the impact of intermental activities (e.g., student collaboration over an electronic network) on intramental processes (Meloth & Deering, 1994; Wertsch, 1991).

One of the major purposes of this study is to describe and analyze student interactions while using an information age tool (i.e., the Internet). Innovative educational activities were used to apprentice young learners into actual environmental and scientific explorations. As a result, opportune questions regarding the social and cognitive benefits of new interaction patterns must now be raised in regards to types of mentorship, interaction patterns, levels of questioning, and the interpersonal impact of shared meaning. Just what types of interaction and forms of learning assistance does this type of information highway provide? How might students be apprenticed in their initial attempts to drive the highway and form new learning collaborations? These are a couple of the questions that emerge when learning theories are married to deliverable technologies.

A Sociocultural Lens on-Line Collaboration

Among the ramifications of Information Age educational tools such as the Internet is collaborative computing. For example, students might send messages to distant people or distinguished experts on a topic, while teachers are collaborating with their colleagues. Ishii (1993) asserted that the increasingly use of telecommunications will build an "essential foundation" for collaboration. Collaborative work in online communities becomes an effective way of using these information age tools (Harasim, 1989; Ruopp, Gal, Drayton, & Pfister, 1993). If predictions hold, students will be empowered and proactive in their collaborative learning processes. Riel (1993), for instance, argues that these online communities will provide a global education for students, enabling them to see the complexity of the world through other viewpoints. Through collaborative environments, students can appreciate the complexity of issues and consequences of their actions. According to Riel, this global community can promote positive attitudes and greater global awareness.

Riel (1985) contends that these new possibilities for cooperative learning and students' interactions engage students in a process of creating shared meanings. In her opinion, online networks create new possibilities of teaching and learning by "facilitating group communication among classrooms and teachers" (Riel, 1990) and fostering collaborative production and analysis of information (Riel, 1992). Bannon (1986) similarly notes that computer-mediated communication (CMC) will "help to create new communities of people, bound by a shared interest in a topic or a shared background." Hence, the interaction between humans and computers should not only be investigated through a cognitive lens, but also through a social lens (Brown, 1986; Scott, Cole, & Engel, 1992). Brown indicates the need to observe and make sense of the social interactions of users who interact with collaborative, online systems. In such an analysis, one begins to distinguish how students can broaden their perspectives through global education and computer-mediated communication and become full participants in it (Riel, 1993).

Theoretical Framing of this Sociocultural Lens

In this developmental theory, human mental functioning is inherently situated in social interactional, cultural, institutional, and historical context (Wertsch, 1991). Basically, an individual derives meaning from the tools and signs mediating his social and individual environment within the phase of development Vygotsky refers to as the zone of proximal development (ZPD) (Salomon, 1988; Wertsch, 1991). A ZPD, the distance between a child's independent problem solving level and the that obtained under adult guidance or in collaboration with more capable peers, might be evident when peers can teach other students about his or her particular community when using on-line technologies. Note that recent collaborative writing studies lend evidence that students' internalize the scaffolding of more capable peers when collaboratively writing (Daiute and Dalton, 1988) as well as the cognitive supports or prompts provided by computer tools (Salomon, 1988; Zellermayer, Salomon, Globerson, & Givon, 1991). However, Salomon (1993) cautions that intellectual benefits will depend on the extent of student "mindfulness" or engagement when collaborating with peers using technology.

More capable peers or adult guides on a computer network may lead students into writing or communication tasks in which they might not typically consider or address. Likewise, from a Piagetian standpoint, debating and dialogue with peers over a network guides and challenges learners to new levels of growth and understanding (Clements & Nastasi, 1988). When confronted by alternative views and opinions, cognitive dissonance or disequilibrium is triggered, thereby causing individuals to seek additional information to resolve to conflict (Piaget, 1963). Both Vygotskian and Piagetian theory, therefore, seem to have foreshadowed the emergence of collaborative technologies.

Another developmentalist, Robert Selman (1980), suggested that educators need to devise new ways for students to progress beyond their egocentric views of the world. His construct, perspective-taking or social cognition (i.e, "to infer another's capabilities, attributes, expectations, feelings and potential reactions," Selman, 1971) has been studied in a variety of settings during the past thirty years. Similar to Piaget's (1963) cognitive developmental theory, Selman (1976, 1980; Selman & Byrne, 1974) has outlined a social cognitive developmental model with five distinct stages. Selman proposed that children gradually decenter from egocentric points of view to the ability to take into account one or more points of view simultaneously. For instance, the sharing of views on a computer screen might foster meaning making activities and interpersonal understanding. Such shared experiences with distant peers on a computer network offers a window into how points of view diverge and a channel for displaying them. Clearly, situating the idea of role play within an electronic collaborative network, enhances the opportunities for developing social cognitive skills.

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Merging Theory and Technology With Cognitive Apprenticeships

Though global education might elevate social cognitive skill and scaffold the learning process, there is no guarantee that collaboration and interaction will trigger critical reflection on one's ideas or enhance interpersonal understanding. New forms of mentoring and teaching assistance might address this dilemma (Tharp & Gallimore, 1988). But how might one assess the forms of this teaching assistance? How might social interaction and discourse be altered by the participant structures and degree of status among the participants? How might cognitive engagement be augmented by the task structuring and questioning provided by electronic mentors?

Evidently, scaffolding and feedback is not restricted to one's peers and classroom teacher, but now guidance comes from other teachers, consultants, and experts who apprentice learning in these new forums. As a result, the "social and intellectual connectivities" (Harasim, 1989, p. 39) afforded by collaborative technologies advance both the educational boundaries and concerns. Expanding the frontier of education, naturally, places the participants in uncharted waters. Regardless of the terminology--coordinators, coaches, advisors, or guides--the apprenticing opportunities are central to success here. Lehrer, Erickson, Love, and Connell (in press) asserted that the notion of an apprenticeship might translate sociocultural principles into "good" instructional practice. In a related article, Lehrer (1993) contends that instructional practices within apprenticeship environments, therefore, might guide students into the learning process, promote student design of knowledge, multiple representations of that knowledge, and student-student dialogue, integration, and presentation of that knowledge (Lehrer, 1993). Rogoff's (1991) findings that adult-child dyads often foster more sophisticated problem solving then child-child dyads support apprenticeships or "guided participation" educational activities.

Guided learning activities that involve students in challenging and internally controllable activities empower learners and facilitate their active construction of knowledge (Wells & Chang-Wells, 1992). According to Wells and Chang-Wells, assisted performance might further draw students into an inquiring community of learners. As experts in the community assist novice learners in assuming a greater portion of the responsibility or intellectual burden of the task, they begin to appropriate and internalize authentic cultural practice. Using technology to build communities of practice and apprentice less skilled learners through social interaction and dialogue is now possible through a on-line educational network. An expert can arrive on a network and participate with learners in a joint learning activity wherein the expert might provide data, demonstrations, or hypotheses. Novice learners, in contrast, might seek additional information, ask questions, or offer tentative conclusions and recommendations. Teachers or cognitive coaches might mediate between these two roles, by establishing the initial goals or tasks, stating necessary assumptions, model expected thought processes, and guiding the overall learning process through support, hints, and clues (Collins, Brown, & Newman, 1989).

Since the seminal article on the emergence of cognitive apprenticeships in education by Collins et al. (1989), educators have sought new avenues for creating mentor-apprentice relationships and embedding the learning in a more legitimate social context. Instead of a continuation down the path to inert knowledge, schools are searching for maps to more realistic learning situations and avenues. The cognitive apprenticeship reviewed here is one plausible means to realize these goals.

Method

The World Forum Activities

The World Forum, developed by the University of Michigan, is a key component of the World School for Adventure Learning currently regulated at Indiana University. The World Forum is an online asynchronous telecommunications project designed to give middle and high school students the opportunity to interact with each other about critical environmental and social issues. This particular analysis involved students in six middle schools and six high schools participating in the World Forum.

As World Forum participants, a student group (with two or three students) would assume the identity of a famous person; for example, one student group might represent Jacques Cousteau while another student group might represent Margaret Thatcher (see Appendix A). These students would conduct background research on their particular character in order to effectively participate in the World Forum explorations and activities. Additionally, the student groups were expected to connect online with the World Forum daily.

There were four main participants in the World Forum: (1) World Forum organizers, (2) World Forum mentors, (3) World Forum participants (i.e., students) and (4) Arctic explorers. The World Forum organizers created two key activities: *Flash Points* and *Arctic Alerts*. In one activity, student groups were asked to respond to statements called *Flash Points*, in similar manner the character they were assigned to researched. For example on a Likert scale (where Strongly agree = 1 and Strongly disagree = 5), students would voice their opinion on a statement such as, "The pen is mightier than the sword". They would either agree or disagree with this Flash Point and state their reasons for their particular opinion.

Arctic Alerts, the second instructional activity, were news reports that described critical environmental and social issues in the Arctic region. One *Arctic Alert* explored the issues of oil exploration on native Eskimo's land. World Forum participants responded positively or negatively to these issues. World Forum student groups also received reports from an Arctic expedition conducted in the Spring of 1994. Student groups were encouraged to pose questions to the Arctic expedition team. Though participation ultimately varied, students were instructed to log-in to the World Forum each day and voice their responses to the aforementioned activities. As part of the instructional design of the World Forum, throughout these interactions the student groups were assisted by World Forum mentors who questioned and guided the student groups' understanding of these environmental issues.

Student interactions via the World Forum lends insight on the process of effective and ineffective asynchronous collaboration. By analyzing these processes, asynchronous on-line communications designs can be improved. There are several important questions to ask about the nature of this type of collaboration. First of all, what kinds of social spaces do participants feel comfortable and uncomfortable in? Secondly, what kinds of communication facilitate a common sharing of knowledge? Third, how are shared meanings constructed? However, since this paper is concentrating on the mentor-student relationship, it is important to ask about the types of learning assistance specifically provided within these virtual cultures. That is, how do these teleapprenticeships (Levin et al., 1987; Teles, 1993) guide their students/tutees through this new medium and successfully communicate with other peers.

In addressing these questions and concerns, the research turns from hardware connection and information access issues to ones regarding how mentor assistance and scaffolding is embedded in e-mail dialogue. The analysis tools and coding schemes chosen here offer insight into the how social interaction impacts student learning. These coding schemes were designed to provide insight into how to measure the activity setting of collaborative computing. The four variables chosen are discussed below.

Data Analysis Procedures

To analyze the interactions between World Forum participants and their mentors, all World Forum discussion strands from the participants and mentors but not explorers were subscribed to. After the World Forum finished approximately eight weeks later, this data was downloaded and printed out for further analyses. As noted previously, only student and mentor interchanges were saved and analyzed here; explorer notes to students were not included in this analysis. By having students assume fictitious identities, all student data was anonymous. All dialogue data was time and date stamp with school indicators. Though student participants were asked to log on each day, more activity was logged during the first few weeks than during the later weeks.

Four analysis techniques emerged after surveying the three key social interaction activities of the World Forum mentioned earlier, namely, Flash Points, Arctic Alerts, and Student Questions to Arctic explorers. The different analysis techniques selected here were based on the particular content of these three activities. Below, we briefly describe each analysis technique and how we applied these techniques to World Forum interactions.

I. Interaction Tabulations and Analyses

The first analyses of the middle and high school data entailed counting the number of student generated interactions concerning the Flash Points, Arctic Alerts, and Student Questions to Explorers. After taking out interaction headers, a computer count of the total number of words composed by middle school and high school students during the three activities. The number of interactions was divided into the total word counts to calculate words per interaction. Counts of the number of mentor-student interactions also were noted.

II. Tharp and Gallimore's six means of assistance

Tharp and Gallimore (1988) offer insights into effective means of facilitating students understanding. With their argument that schools should provide assistance for the entire school community, Tharp and Gallimore identified six means of assisting performance including: Modeling, Contingency Management, Feeding-back, Instructing, Questioning, and Cognitive Structuring. These six techniques of assisting understanding can contribute in facilitating both mentor and students participation in Collins et. al.'s (1989) cognitive apprenticeship. Thus, interactions between mentors and World Forum middle school and high school were coded using Tharp and Gallimore's framework. Questions of interest included whether the assistance varied across group and task structure, as well as, over time. For instance, what types of learning assistance do students need? And does this mentors assistance vary with younger students and older students or from beginning to later sessions? To begin to discern answers, percentages of interactions involving each assistance mode were calculated for both grade levels as well as overall interactions.

III. Bloom's taxonomy of educational objectives

Paralleling the forms of assistance, was a concern with the level of questioning in electronic social interaction and discourse. Though decades old, Benjamin Bloom's (1956) cognitive taxonomy from low level knowledge, comprehension, and application goals to high level analysis, synthesis, and evaluation educational objectives was useful in analysis electronic discourse. Though these question types have been used during the past four decades to illustrate the lack of high-level questioning in the classroom, perhaps electronic interaction in a community of discourse would elevate observed questioning level. Bloom's taxonomy definition helped measure the levels of thinking that World Forum participants used when asking questions to Arctic explorers. We speculated whether engaging in the other World Forum activities (i.e., Flash Points and Arctic Alerts), students would gain more expertise and express this new knowledge with higher level questions. Moreover, would students internalize and exhibit the types of questions asked by their World Forum mentors?

IV. Selman's Perspective-Taking

In adopting the latter four of Selman's (1980) perspective-taking categories, coded interactions with both the Flash Points and the Arctic Alerts with Selman's perspective-taking coding scheme. The primary question asked was whether students' perspective-taking would be enhanced in one activity rather than another one. Would students' responses to Arctic Alerts encourage higher levels of perspective taking than Flash Points? Secondly, we asked whether older students would exhibit higher levels of perspective-taking than middle school students. Of course, most students in World Forum interactions involved role playing from the perspective of a famous person; hence, participants were already at operating above initial egocentric level.

Results

In first, taking a quantitative look at the data, we found that the number of interactions recorded in World Forum (see Table #1), both middle and high school students wrote a similar amount of messages (Flash Points, Arctic Alert responses, and Questions to Arctic explorers). The Flash Point activity was used the most. It is interesting to note that high school students used much more words per average in Flash Points and their Student Questions to Explorers than middle school students (i.e., 7805 words as opposed to 4808 words in Flash Points; 1030 words as opposed to 625 words in Student Questions to

Explorers). Surprisingly, the student interaction activity decreased during the eight weeks and direct student-student interaction throughout the project was minimal.

Table 1 also indicates that World Forum mentors focused the Arctic Alert activity on middle school students (i.e., 7 as opposed to 1), whereas their Flash Points and Student Questions to Explorers provoked more high school student interactions (31 and 13 interactions, respectively, for high school students compared to 15 and 1 middle school).

World Forum mentor interactions, the coding scheme based on Tharp and Gallimore's forms of learning assistance (see Table #2), disclosed that the Questioning technique was the most frequently used with novices. Surprisingly, one of the six forms of assistance, namely modeling, was totally absent. Mentors could have used this technique to promote more interactions among students. For instance, in the beginning of the World Forum, modeled interactions could be demonstrated to middle and high school students. This technique would lay the ground work on how to properly interact with other World Forum participants. The Contingency Management also could have been used to facilitate this interaction. In the beginning of the World Forum, mentors could have reminded World Forum participants that they should respond to their counterparts. By "managing" these students, there could have possibly been more peer interactions. Overall, World Forum mentors did a good job of asking questions and providing cognitive structure to the task, but failed to provide a framework of how students should properly interact with one another.

A majority of both middle school and high school student questioning activities to the Arctic explorers (see Table #4) appear to be at lower-level thinking on Bloom's taxonomy (i.e., Knowledge and Comprehension levels). There was no apparent transfer, therefore, from engaging in the other World Forum activities (i.e., Flash Points and Arctic Alerts). However, since there were only thirty questions, this speculation cannot be confirmed. Again, we would recommend that World Forum mentors and staff model higher-level questions for World Forum students or give out sample questioning sheets to guide their early interactions.

Examining students' perspective-taking abilities (see Table #5), we found that both World Forum activities (i.e., Flash Points and Arctic Alerts) promoted higher-level perspective taking. Though 51% of middle school students' responses to Flash Points were scored a "1" (Subjective perspective-taking), almost 20% of their responses were a "4" (Societal perspective-taking) (see Appendix E for sample of each perspective-taking level within Arctic Alerts responses). High school students fared better with Flash Points; 26% of their responses were a "3" (Third-person perspective-taking) and 31.4% of their responses were a "4" (Societal perspective-taking). For Arctic Alerts, both middle and high school students had higher perspective-taking levels. In fact, it appears that Arctic Alerts promoted more "3" perspective-taking among both groups of students than its Flash Point counterpart. In either case, high schools were interacting at a predictably higher level of perspective-taking than middle school youth.

Conclusion and Implications

The World Forum, developed by the University of Michigan, simulated an on-line discussion between middle and high school students about critical environmental issues. The intention of this instructional activity was for students to assume the identities of famous characters and communicate with their peers, explorers, and mentors about these environmental issues. Student interactions on the World Forum, were analyzed using four different analysis methods, namely, frequency of responses as well as analyses derived from the work of Tharp and Gallimore (1988), Bloom (1956), and Selman (1971). Results indicate that the World Forum participants assumed higher levels of perspective-taking, but lacked any significant amount of peer collaboration. World Forum participants demonstrate fairly high perspective-taking abilities while engaging in Flash Points and Arctic Alerts. The longer and more contemporary, Arctic Alerts, were responded to at a slightly more higher level. Though students demonstrated these higher-level abilities, especially high school students, they did not transfer this knowledge when asking questions to Arctic explorers. Instead their questions remained primarily at the Knowledge and Comprehension levels. Combined with the findings on mentor assistance, our results indicate that proper mentoring for students engaging in computer-mediated communications, should extend beyond mentors providing tasks and questions to better organizational the task and model appropriate responses.

The analyses also corresponded with expectations of developmental differences from middle to high school. High school students, on average, wrote more lengthy responses than middle school youth. More specifically, grade level differences indicate that the longer and more concrete Arctic Alerts may provoke more discussion among middle school students than high school students. The fact that the more thought-provoking Flash Points and Student Questions to Explorers were utilized by older students corresponds with their ability to reason at high levels than younger students (Piaget, 1963). In terms of direct form of assistance, mentors provided equivalent amounts of feedback, questioning, instructing, and cognitively structuring the tasks to both age groups, but used behavioral management slightly more often with younger students. In terms of level of questioning, too few questions were asked to infer any developmental differences. Finally, the perspective taking analyses indicated that older students responded to Flash Points and Arctic Alerts at more often at Selman's upper levels of social cognitive ability or judgment than the early adolescent students in this study. As predicted (Muuss, 1988), as children mature, role taking activities or the ability to make inferences about the other people's capabilities and potential reactions become easier. Overall, these codings of electronic data, though tentative, begin to detail why innovative social interaction formats may need to consider student developmental level.

The World Forum is promoted as an exemplar tool for students to engage in critical environmental and social issues from another person's perspective. It is a means to marry simultaneous advances in theory and technology. Through programs like the World Forum, electronic collaboration between students, teachers, and experts is beginning to dramatically impact educational settings by fostering more learner-centered activities and opportunities to socially share meaning. In using the Internet, several novel, on-line educational activities were created to communicate with peers, assume roles, and create meaning and share opinions with researchers and explorers. As more apprenticing opportunities emerge from computer-mediated communication environments, additional understandings are needed of how the intermental processes among participants become internalized as independent problem solving processes. Extensive research is needed to examine how best to design similar instructional tools.

Future research ideas spin-off from each limitation of this study. First of all, we did not manipulate the interactions among participants, but simply analyzed the social interaction and dialogue of students and schools within an existing program. In a follow-up effort, researchers might want to suggest tasks or collaboration patterns that participants will use. Variations in the role taking or questioning of explorers, for instance, may enhance the findings found here. At the same time, additional training of mentors or explorers may scaffold their ability to model higher levels of thinking, questioning, and perspective taking than witnessed here. Peer training also may prove fruitful, since few of the student interactions noted here directly addressed peers at participating schools. Of course, other researchers might want to perform similar analyses on the piece of data we were missing, namely the explorer responses and written notes to the student participants. Third, the researchers here simply downloaded existing data without verifying their interpretations with the teachers or students. In contrast to this approach, researchers might want to use social interaction data as an instructional tool that students and teachers would evaluate both before and after it was coded for form of assistance, questioning, and perspective taking. In fact, such dialogue transcripts might be useful for preservice teacher education programs struggling with how to concretize sociocultural concepts such as scaffolding, zones of proximal development, and assisted learning. Of course, though student competence is the ultimate goal, we did not compare student performance or address learning transfer to other classroom activities.

Despite these limitations, some of the tasks and approaches used here help clarify the impact of social interaction on student learning. Human learning and development theory was used as a guide in assessing the impact of new technologies and interaction structures. Certainly these coding schemes for analyzing questions asked, help provided, and perspectives taken can be further refined or altered for other collaboration formats. Indeed, there are additional variables, coding schemes, technologies, and instructional design models to consider. Though network and on-line education technologies are changing faster than research studies can be designed, in this study, we used four assessment techniques that were specific to the social interactions and mentorship of the World Forum. It is a start. Future activities might explore additional World Forum data and fine-tune these initial social interaction coding schemes for collaborative learning and e- mail dialogue. Nevertheless, we are beginning to peer into how social interaction and discourse influence electronic group activities and resulting cognitive change.

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Table 1.
Student Interaction by Activity in World Forum Dialogue

Interactions/Activity	#of messages	# of words	Average # words	# of mentor/student interactions
Flash middle school:	101	4808	39	15
Flash high school:	123	7505	77	31
Arctic middle school:	56	4369	78	7
Arctic high school:	45	3898	86	1
Questions middle school:	16	625	39	1
Questions high school:	13	1030	79	3

Table 2.
Forms of Teaching Assistance in World Forum Dialogue
(Note: usually, there were more than one mode of assistance per mentor-student interaction; hence, there are more assistance techniques than interactions. Also, modeling was not displayed by World Forum mentors.)

	Fdbk	Q'ing	Cog. Struct.	Instruct.	Model	Cont. Manag.
Flash middle school:	2	9	4	3	0	2
Flash high school:	7	25	15	5	0	0
Arctic middle school:	4	4	3	0	0	2
Arctic high school:	1	1	1	0	0	0
Questions middle school	1	1	0	0	0	0
Questions high school:	9	12	5	6	0	0

Table 3.
Forms of Teaching Assistance in World Forum Dialogue

Middle School Total: 35 Mentor-Student Interactions
- Feedback- 20%
- Questioning- 40%
- Cognitive Structuring- 20%
- Instructing- 8.5%
- Modeling- 0.0%
- Contingency Management- 11.4%

High School Total: 87 Mentor-Student Interactions
- Feedback- 19.5%
- Questioning- 43.6%
- Cognitive Structuring- 24.1%
- Instructing- 12.6%
- Modeling- 0.0%
- Contingency Management- 0.0%

Overall Total: 122 Mentor-Student Interactions
- Feedback- 19.6%
- Questioning- 42.6%
- Cognitive Structuring- 22.9%
- Instructing- 11.4%
- Modeling- 0.0%
- Contingency Management- 3.2%

Table 4.
Level of Student Questions to Arctic Explorers in World Forum Dialogue

	Know.	Compre.	Applic.	Anal.	Synth.	Eval.	Total:
Middle School:	5	6	0	1	0	4	16
High School:	7	5	0	1	1	0	14
Overall:	12	11	0	2	1	4	30
	40%	36.7%	0.0%	6.7%	3.3%	13.3%	

Appendix A
Sample of characters role played by Some World Forum participants

Green Delegation
- Professor Stephen Jay Gould
- Monsieur Jacques Cousteau
- Senor Roberto Clemente
- Senora Eva Peron
- Professor Sissela Bok
- Mr. E. F. Schumacher

Purple Delegation
- President Lech Walesa
- Ms. Petra Kelly
- Pope John Paul II
- Prime Min. Kazimiera Prunskiene
- Mr. Ernest Hemingway
- Mr. Stephen Biko

Title:

Proficiency Orientation in Foreign Language Education: Implications for Instructional Design

Author

Stanley B. Supinski

What is Proficiency?

In second language education circles for the past ten to 15 years, the word "proficiency" has generated considerable debate and controversy. The word does not simply represent "a quality or state of being proficient," as Webster (1993, p. 931) would have it, but instead has become a synonym for the proficiency movement or the shift toward proficiency-oriented instruction (Birckbichler & Corl, 1993). This movement and mode of instruction are at the heart of the paradigm shift the second language community has undergone that closely mirrors general trends in education toward holism and constructivism.

For the second language student, proficiency is a measure of what tasks can be accomplished with acquired language and how well they can be accomplished. The task can be registering for a hotel room or ordering a meal in a restaurant, and the "how well" is not only receiving the room and meal intended, but also understanding associated cultural and sociolinguistic connotations of these communicative events. Such an accomplishment may seem the logical outcome of any second language program, however, this was not the case prior to the adoption of proficiency-oriented instruction.

Most programs dating back at least 10 or so years, (and actually many still today) focused more on the structure of language; not necessarily on what you can do with it. The teaching methods employed paralleled those generally used in education at the time: reductionistic, structured approaches emphasizing behavioral objectives, or as Higgs (1984) described them, a "marriage of linguistic (structure) theory and learning (behavior) theory "(p. 2).

The audiolingual method was a common technique. Students repeated, and committed to rote memory, isolated words and phrases. Audiolingualism closely paralleled the instructional systems design (ISD) field's method of programmed instruction. The methods were adopted from B.F. Skinner's theoretical work in behaviorism and systems approaches. Programmed instruction reduced tasks to small components, provided learners frequent feedback, and defined specific measurable objectives which could be readily assessed (Seels, 1989). This method was widely used in military training which, in turn, significantly influenced the civilian foreign language community.

The structured approaches revolved around the linguistic elements, specifically grammatical, phonological and syntactic features of language--elements readily and reliably defined. Evaluation was typically accomplished using discrete-point tests with completion or multiple-choice questions on grammar (Liskin-Gasparro, 1984). While such methods allowed inexperienced teachers to teach large numbers of students, students often were unable to transfer knowledge outside the classroom; in a foreign language sense, they were functionally illiterate.

In the late 1960's an evolution toward communicative approaches began. The objectives of these approaches are to target a task, such as obtaining a hotel room or ordering a meal, and gaining the level of communicative proficiency necessary to successfully complete the task. This paradigm shift necessitated specification of functional proficiency, a job undertaken by the American Council on the Teaching of Foreign Languages (ACTFL) and the President's Commission on Foreign Language and International Studies. Results of this effort were the ACTFL Proficiency Guidelines, published initially in 1982 and revised in 1986, and the adoption of proficiency-oriented methods on a broader scale.

The ACTFL guidelines delineate functional proficiency in five areas (speaking, writing, reading, listening, and culture) at five levels (novice, intermediate, advanced, advanced plus, and superior), with the novice and intermediate levels further categorized as low, medium or high. The example below is the guideline for speaking, intermediate-mid level:

> Able to satisfy some survival needs and some limited social demands. Is able to formulate some questions when asked to do so. Vocabulary permits discussion of topics beyond basic survival needs such as personal history and leisure time activities. Some evidence of grammatical accuracy in basic constructions, for example, subject verb agreement, noun-adjective agreement, some notion of inflection.

The guidelines are intended to be descriptive, but their inherent hierarchical structure often encourages prescriptive use. Higgs (1984) refers to the guidelines as "the organizing principle" (p.4), and Liskin-Gasparro (1984) identifies the guidelines as "a graduated sequence of steps that can be used to structure a foreign language program" (p. 11). The guidelines are not the driving force behind the proficiency movement, but a component that has simplified the process of operationalizing proficiency-oriented methods.

This is a paradigm shift in the true sense of the word, as communication has become the focus of language instruction which is where, in my opinion, it should belong. However, as previously mentioned, not everyone has adopted proficiency methods; many programs and individual teachers still focus on grammar translation.

Applying Instructional Systems Design to a Proficiency Oriented Foreign Language Program

Many in the foreign language community have dismissed instructional systems design (ISD) as being able to make a contribution to their field. This may stem from the fact that ISD is rooted deeply in Skinner's work and behaviorism, and that it may not be "politically correct" to hold behaviorist philosophies. However, for a couple of reasons, ISD can be of great value in designing a language program.

First is the unfolding of the proficiency movement. It has often been left up to the individual instructor to incorporate the tenets of proficiency into instruction. The individual instructor can use systematic ISD to appreciably aid in the selection, application and optimization of instructional goals and methods. A second reason is the ever increasing availability of emerging technologies. Success or failure of any technological aid, such as computer assisted language learning (CALL) or interactive video instruction (IVI), will have less to do with what it can do than what we are actually doing with it (Underwood, 1984). Here again, ISD can aid integration and optimization.

The remaining portion of this paper provides five general guidelines which can help in designing a second language program. These are guidelines for anyone working to develop a language instructional program, which can include an instructional designer working with a subject matter expert (often the linguist or language teacher), or the second language teacher as well. Many of these guidelines are just basic common sense, but following them without skipping any of the steps is a way to improve an existing program or develop a new one. The guidelines closely mirror the steps in the ISD process; the steps, as defined by the Dick and Carey (1990) model, and how they are supported by each guideline, follow. Lastly, these guidelines are primarily for the instructor-led classroom.

Guideline 1 - Use the ACTFL proficiency guidelines. Analyzing and identifying instructional goals is simplified by the ACTFL proficiency guidelines. They delineate functional orientation and specific accuracy levels in each of the five areas of reading, writing, listening, speaking and culture, serve as goals for courses and individual lessons.

They are often overlooked, but a good deal of effort went into their development, and they can provide a solid reference point for the first three phases of the ISD process.

ISD Step: Identify Instructional Goals - The guidelines provide a ready made set of specific instructional goals. Obviously, the goals of the program being designed may will likely not match perfectly, but if the focus is proficiency oriented, or perhaps more specifically focused on writing, speaking or another skill, the guidelines do provide a good starting point. The basic guidelines can also be applied to specific content area of instruction, such as an English for Special Purposes program that teaches how to complete a job application, if this is the focus.

ISD Step: Conduct Instructional Analysis - Most language use requires gaining some verbal knowledge (vocabulary) followed by a knowledge of structure or a grammatical rule (or an intellectual skill) in order to properly use the vocabulary. Most lessons developed will follow this pattern. Further analysis should focus on the type of communicative skill in which proficiency is desired, and on the specific content of the lesson.

ISD Step: Identify Entry Behaviors and Characteristics - The guidelines state specifically what learners should be able to do after instruction. Omaggio (1984) stresses the value of the guidelines hierarchical form:

> The guidelines are (also) ideally suited for organizing instruction because they are progressive. Knowing what competencies lie at the next level will help us sequence materials to conform to natural developmental patterns in adult second-language learners and prepare them for making progress. The descriptions will also allow us keep in mind the ultimate goal(s) learners hope to achieve. (p. 44).

The hierarchical nature of the guidelines indicate what skills should be achieved at Novice (low, medium, high), Intermediate (low, medium high), Advanced/advanced-plus, and superior. Prior to designing instruction at a particular level, the previous level should be achieved as entry level behavior.

Guideline 2 -Write Specific Performance Objectives and Criterion Referenced Test Items Before Developing Instruction: Matching test items with instructional goals has been one of the most problematic areas of language programs. Basic ISD practice, however, can help alleviate this problem, particularly if the goals have been clearly delineated as discussed above.

ISD Step: Write Performance Objectives - Using the skills identified in the instructional analysis, performance objectives that indicate the conditions and criteria that are required of the learner should be prepared. These conditions should include what information is to be given to the student beforehand, what type of skills (oral, written, etc.) will be expected, and specific criterion on the structural accuracy required. For example: "When given a written scenario in which two people interact, the learner will write a Russian greeting and form of address of the appropriate formality. Items must be spelled correctly." These items again closely reflect the ACTFL guidelines, but will make it clear to the learner what performance is expected, and make it easier for the instructor to develop the instruction and evaluate the student.

ISD Step: Develop Test Items based on the Objectives - Student evaluation should be criterion referenced, though there is a tendency to compare student performance.

Also on testing, Liskin-Gasparro (1984) recommends specific assessment objectives based on the three elements of the guidelines, which define functions the speaker can express, the content of those functions, and the degree of accuracy. The last function, accuracy, can be evaluated in typical discrete point fashion, however, recall that the proficiency movement emphasizes moving instruction away from linguistic structure. The focus is thus on the first two areas, function and content.

The most obvious method to test an acquirer's proficiency or communicative competence is with an oral interview, which measures both aural comprehension and speaking ability. Krashen and Terrell (1983) recognize the value of lengthy oral interviews, however, they also recognize that conducting such interviews with large classes may not be feasible. A possible solution is testing supported by CALL, which can reduce the interface time between student and instructor. Students viewing video or text can be tested for aural and reading comprehension, and can also be tested for writing in the target language by producing summaries. The instructor's time with each student is significantly reduced as only speaking abilities need to be evaluated during oral interviews.

Guideline 3 - Make the Classroom Learner-Centered:

ISD Step: Develop Instructional Strategy. The Proficiency means that students must practice the skills that they are to attain. This means that they, not the instructor, should be the focus of any language program. A variety of activities that require student performance, small group work that increases their opportunities and reduces anxiety, and making lots of input, at the appropriate level, available, are strategies to be considered.

An argument may be made that the more learner-centered the classroom, the weaker the notion of controlled, criterion based objectives. Learner-centered does not necessarily mean that learners can go off in any direction they see fit, but instead means that they should be active participants. Students listening to a dialog between the teacher and one other student should be minimized. While an acceptable balance must be found, the more the students participate, the better.

Guideline 4 - Integrate Instructional Materials and Media:

ISD Step: Develop and Select Instructional Materials. Effective use of materials in a proficiency-oriented environment is another significant problem facing language educators today. The quantity and quality of available resources, particularly those that are technology based, vary significantly between languages.

Selection of materials should begin with a comprehensive review of instructional goals (which level of proficiency), the strategies selected, and all materials available for the language selected. Materials that support proficiency-based instruction, such as newspapers, television broadcasts, and films, should be considered as they provide input variety and authenticity. Textbook use should be limited to those that have evolved from grammar-based to functional/notional-based, as available. Second language teachers, in a survey by Birckbichler & Corl (1993), cited "goals stated in terms of communicative functions" as the most critical factor in textbook selection. Other important factors noted in the survey included varied activities, contextualized exercises, and adherence to ACTFL proficiency guidelines for topics and sequencing. Instruction often closely adheres to specific texts, which despite the proficiency movement are linguistic structure oriented (Birckbichler & Corl, 1993), and do not allow for any supplemental activities.

Due to the flood of new technology based materials, primarily CALL and IVI, particular care should be taken when selecting and incorporating them into a program. The issues to consider include what levels of language acquisition are best served by CALL or IVD, determining the correct mix of language lab and classroom time, and obtaining software and materials matching curricula. The approach generally used in second language, as with academic fields outside of second language, has been to use CALL/IVD applications to fill gaps in curricula. Integration must begin with strategically placing CALL/IVD where it is most efficient. Video segments and hypertext exercises must be carefully matched to course objectives, student abilities and interests, and to other classroom activities.

A basic approach is to use the level of the language acquirer to determine how much technology to use. In the early stages of language instruction, in which the lexicon must be the focus (Higgs, 1984), along with orthographies in some languages, CALL/IVD applications serve to link lists of vocabulary to context. Hypertext and hypermedia incorporate embedded strategies not typically utilized in other disciplines, such as chunking/clustering and frequent short periods of review (McCoy & Wieble, 1983). They can also provide appropriate sequencing and short video clips to provide context. Instructors need not rely strictly on the CALL/IVD application. Providing vocabulary lists and themes in advance and follow-up by shaping classroom activities around lab work will enhance acquisition.

The early stages require the greatest degree of independent effort as insufficient lexical development precludes communicative activity. Otto (1989) believes this is where the concentration of CALL/IVD applications should lie, but often does not. Krashen and Terrell (1983) identify a period early in the acquisition process, the silent period, in which acquirers say very little except for memorized whole sentences. During this period they are building the confidence and the lexicon necessary to produce language. Larger proportions of time devoted to independent CALL/IVD activity during the silent period help focus on aural activity and reduce anxiety producing oral production. Independent activity in the early stages will also improve attitudinal factors.

At intermediate levels, increasing the quantity and quality of input to support expansion of vocabulary is the focus of strategy when designing instruction. Dick and Carey's (1990) strategy of organization is most appropriate at this level in a proficiency- based curriculum. Presenting vocabulary in functional or topical subsets creates a framework for classroom activity. For example, with the theme of ordering a meal in a restaurant, food can be a subset around which numerous activities can be developed.

Interactive programs should be combined with paired or small group work, with functionally based content. CALL/IVD applications play an obvious role at this level, but they cannot stand alone. Follow-up with classroom discussion of the events of the video, strictly in the target language, will assist in long term retention and encoding. Intermediate levels should also provide opportunity to demonstrate proficiency with simulations and questioning about similar personal experience.

Advanced levels of language study require a lower proportion of CALL/IVD centered activity due to the level of technology presently available. As real interactivity cannot occur, the genuinely communicative work required at this level must be left to the classroom. Input is still crucial, however, and video, news broadcasts and printed media still serve a substantial role.

Guideline 5 - Evaluate Your Program: Both formative and summative evaluation can improve the effectiveness of second language instruction.

ISD Step: Conduct Formative Evaluation - Formative program assessment should be conducted continuously, modifying methods and activities, updating materials and adding new materials that will maintain motivation. Brierly & Kemble (1991), recommend establishing a lifecycle that continuously analyzes instructional systems to determine if curricular, teacher and student requirements are being met.

An approach modeling Dick and Carey's (1990) three phases of formative evaluation are also useful. One-to-one and small group evaluations can insure that instruction is interesting and motivational. The third phase, the field trial, in which students are placed in realistic situation, mirrors the goals of proficiency orientation. Setting up situations in which students practice language will assess both the student's acquisition and the effectiveness of the instructional program

ISD Step: Conduct Summative Evaluation - Summative evaluation may prove problematic as an outside evaluator, normally an instructional designer, will likely not have acquired the language being instructed. This lack of knowledge complicates the process as the evaluator is not able to judge the effectiveness of instruction. In such cases, the evaluator must work closely with the designer and the teacher to determine deficiencies in outcomes.

Summary

These basic guidelines can provide the language program developer or teacher with enough knowledge of basic ISD methodologies to enhance program development. As previously stated, many of the guidelines are just basic common sense, but following them without skipping any of the steps is a way to improve an existing program or develop a new one. Using a systematic and systems process will improve the chances that established goals can be successfully reached.

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Adoption Analysis and User-Oriented Instructional Development

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Abstract

This paper discusses the importance of considering the social context in which an instructional product will be used during the development process. The authors contend that traditional instructional product development models are inadequate because they ignore social context. The use of inadequate traditional design models results in the development of instructional products that may be instructionally effective but that are not desirable to potential adopters. Two emerging theories, Adoption Analysis and User-Oriented Instructional Development, are presented as tools that instructional developers can employ in order to increase the adoption of their products. The paper describes the importance of incorporating the emerging theories into existing instructional development models. The authors conclude by calling for a new vision of instructional development in which the success of an instructional product is measured by its successful adoption just as much as success is now measured by its instructional effectiveness.

Adoption Analysis and User Centered Instructional Design

Technology is a social phenomenon. The design, development, adoption and diffusion of technology are inherently social processes. Technology is developed by people in a particular environment and culture and is intended to be used by people in a particular environment and culture. As Howard Segal writes in his book ***Future Imperfect*** (1994), "all structures and machines, primitive or sophisticated, exist in a social context and, unless designed for the sake of design itself, serve a social function" (p. 2).

Theorists and practitioners in the field of instructional development (ID) often neglect or ignore the social context into which their instructional products are intended to be used. Dalton (1989) writes about instructional developers that "although we can fill instructional gaps with fervor, we never seem to examine our solutions in light of the wants of the implementors" (p. 22). Burkman (1987) writes that instructional developers commonly believe products which result in more effective and efficient instruction will, as a direct result, be attractive to potential adopters. Ralph W. Tyler (1980) adds that "many developers of technology accept the view that as time passes, there will be increasing use of the innovation until it has become a common element in school practice" (p. 11). The basic fallacy pointed out by these statements is that development of effective instruction combined with the passage of time does not automatically lead to the widespread adoption of an instructional product. Instructional products are too often "designed for the sake of design itself." They are often designed without regard to the social factors that influence adoption and utilization and this results in the development of instructional products that are technically sophisticated and instructionally sound but that nobody uses.

The purpose of this paper is to discuss the process by which instructional products are developed and to describe two emerging theories that might link the people who design instructional technology more closely to the people who are the intended users of the technology. The theories of User-Oriented Instructional Development (UOID) (Burkman, 1987) and Adoption Analysis (Farquhar & Surry, 1994) are potentially powerful tools for instructional developers. By incorporating these two theories into their design activities, instructional developers can create products that are not only "effective and efficient" but that are also useful and desirable to the people who are the intended users.

Limitations of Existing Product Development Models

If we accept the premise that instructional designers often neglect or ignore the social context into which their products are to be used, the obvious next step to ask why this is the case. One likely reason for this neglect can be found by examining the theoretical models commonly used in the field of instructional technology. These models are used by instructional designers and systems developers to manage and organize instructional development activities and to communicate the overall process to clients (Gustafson,1991). Instructional development models provide the procedural framework by which instructional products are produced.

There are numerous models of instructional development. Gustafson (1991) skillfully organizes many of the most widely-used instructional development models into a logically organized taxonomy. Gustafson classifies the models into Classroom ID Models, Product Development Models, and Systems Development Models. For the purpose of this paper, we will primarily discuss the product development models.

Perhaps the most widely used instructional development model is the Dick and Carey Model (1990). While Gustafson classifies this as a Systems Development Model, it is also commonly used by instructional product developers. The Dick and Carey Model (see Figure 1) describes a development process that begins with the identification of goals and proceeds through formative evaluation, revision and summative evaluation. There is little doubt that the model provides a valuable description of all of the key ID activities and places them in a logical sequence. Notably lacking from this model, however, is any mention of the social context in which the product will be implemented.

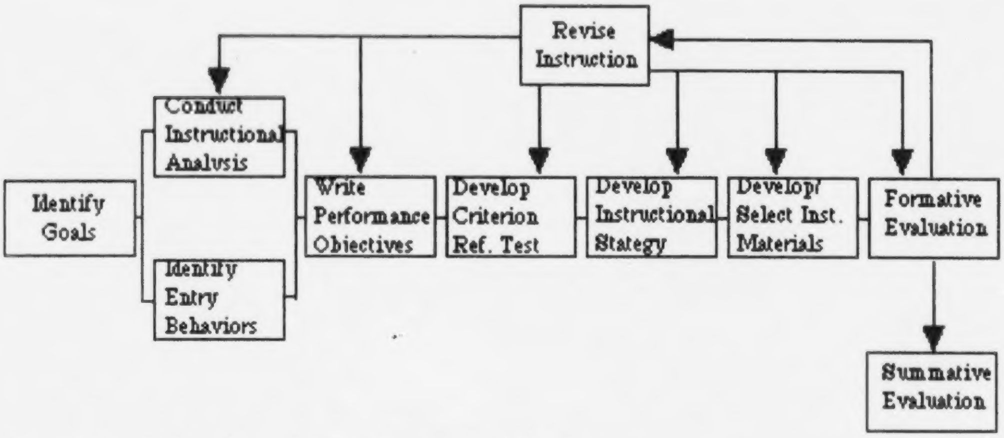
Revise Instruction
Conduct Instructional Analysis
Identify Goals
Identify Entry Behaviors
Write Performance Objectives
Develop Criterion Ref. Test
Develop Instructional Stategy
Develop/ Select Inst. Materials
Formative Evaluation
Summative Evaluation

Figure 1. The Dick and Carey Model of Instructional Development

As with the Dick and Carey Model, other widely used product development models also fail to account for social context. Gustafson (1991) writes that the goal of product development models is "to prepare an effective and efficient product as quickly as possible" (p.7). While all three of the product development models reviewed by Gustafson describe a logical process for developing "an effective and efficient product", none of them contains a thorough discussion of the need to analyze the social context in which the product will be used. In fact, only one of the three, The Van Patten Model (1989), even mentions the implementation or continuing maintenance of an instructional product.

In reviewing Systems Development Models, Gustafson writes that such models usually call for an extensive analysis of the use environment before instructional development even begins. Of the five systems models reviewed by Gustafson, two -- The IDI Model and The Diamond Model -- do discuss in some detail the need for an analysis of the social context. The IDI Model (Twelker, 1972) calls for an analysis of the audience, organizational personnel, and organizational resources before development begins. The Diamond Model (1989) goes even further than the IDI Model and calls for an analysis of societal and organizational needs and for an examination of human and organizational resources before development.

The examination of the preceding instructional development models leads to three important conclusions. First, none of the most widely used product development models include an analysis of the social context as an important part of the development process. Second, product development models do not always mention adoption and diffusion, and when they do, adoption and diffusion are typically considered near the end of the development process, usually after the product has been developed. Third, while some systems development models do tend to call for a thorough analysis of social context, these models are not often used to guide the production of specific instructional products but, rather, are reserved primarily for the development or repair of broader instructional systems.

User-Oriented Instructional Development Theory

As we have seen in the previous section, few product development models discuss sufficiently the need to examine the social and physical environment into which an instructional product will be introduced. Ernest Burkman (1987) was one of the first writers to propose that, because traditional ID models fail to adequately account for the social context, instructional products have, as a direct consequence, failed to be widely implemented. Burkman writes that instructional technology makes extensive use of the research-development-diffusion (RDD) paradigm and that many such endeavors suffer from a lack of utilization. He adds that instructional technology has experienced a lack of utilization in all fields, including primary and secondary schools, colleges and universities, and even in industry and the military.

In order to correct the inadequacy of traditional models, and to increase the utilization of ID products, Burkman proposes the User-Oriented Instructional Development Process (UOID). The five step process (see Figure 2) calls for instructional developers to identify the people who will be using the product, analyze their perceptions about the product and, based upon that analysis, to develop products that are user-friendly.

User-Oriented Instructional Development

Step 1: *Identify the potential adopter*

Step 2: *Measure relevant potential adopter perceptions*

Step 3: *Design and develop a user-friendly product*

Step 4: *Inform the potential adopter*

Step 5: *Provide post adoption support*

Figure 2. The Five Steps in Burkman's (1987) UOID Process

Burkman makes an interesting and valuable point in describing the UOID that is particularly germane to the present paper. He includes three major differences between traditional ID models and his UOID theory. The three differences serve to succinctly define the differences between traditional ID theory and the emerging theories discussed in the present paper. The three major differences between emerging theories and traditional models as identified by Burkman are:

1) Traditional models do not call for instructional developers to measure the perceptions of potential adopters or to develop perception-friendly products

2) Traditional models do not ask developers to formulate messages and select communication channels in order to create favorable perceptions.

3) Traditional models do not demand that instructional developers use adoption and implementation success as criteria for evaluating their products.

One of the main theoretical foundations that underlies Burkman's UOID Theory is E. M. Rogers' (1987) theory of perceived attributes. Rogers writes that all innovations can be thought of as having five general attributes: compatibility, complexity, observability, relative advantage and trialability. The theory states that potential adopters form their opinions of an innovation based upon their perceptions of the innovation's five general attributes. Simply put, Rogers theory states that potential adopters are more likely to use a product if it is compatible with their needs, is not too complex, offers observable benefits, provides some advantage relative to other products, and can be tested or tried out prior to adoption. Burkman expands upon Rogers theory and applies it to instructional innovations by theorizing that instructional developers can increase the utilization of their products by determining and accounting for the perceptions of potential users.

While there are no published studies that specifically support Burkman's UOID Theory, there is a great deal of research to support the theory's underlying foundation that perceived attributes play an important role in adoption. Hurt and Hibbard (1989) write "it is well-documented that the characteristics of an innovation as perceived by potential adopters play a critical role on the rate of acceleration of the adoption curve" (p. 214). Among the more recent studies, Holloway (1977) found that perceptions of relative advantage and compatibility were influential in the adoption of an educational innovation by high school principals. Moallemian (1984) and Weinstein (1986) also found that perceptions played an important role in adoption in educational settings. Surry (1993) found that the perceptions of compatibility, complexity, and relative advantage were important considerations in the adoption of computer-based instructional modules by weather forecasters. Many other studies (e.g., Sekhon, 1968; Rogers, Daley, & Wu, 1982) have found that perceptions played a significant role in the adoption of innovations outside of the educational field.

Adoption Analysis

Adoption Analysis (Farquhar & Surry, 1994) is another emerging theory that is based upon the assumption that existing ID models are inadequate because they ignore the social context into which the instructional product will be introduced. Adoption Analysis is a process that calls for a thorough examination of both the context in which an instructional product will be used and of the people who will use the product. Segal (1994) writes that "if, as in the significant case of the auto, modern technology solved a number of problems, social as well as technical, from the outset it *simultaneously* bred or helped to breed several others, social and technical alike" (p. 30). Adoption analysis, therefore, can be defined as a process that seeks to determine and account for the social and technical problems that will be bred by the introduction of an instructional product into an organization.

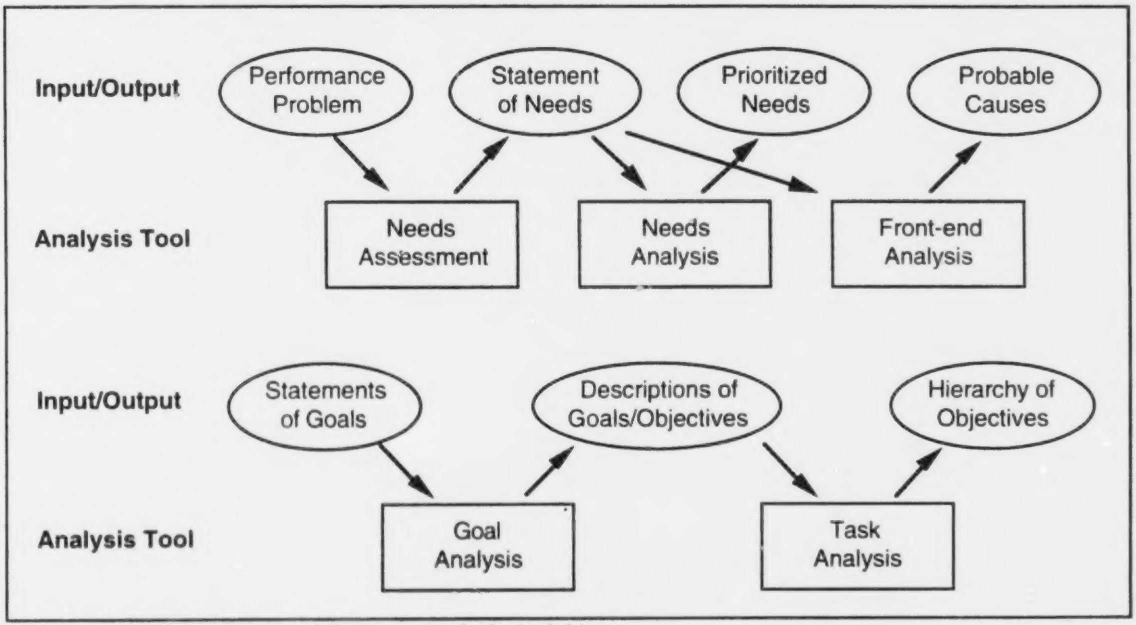
Input/Output
Performance Problem
Statement of Needs
Prioritized Needs
Probable Causes
Analysis Tool
Needs Assessment
Needs Analysis
Front-end Analysis
Input/Output
Statements of Goals
Descriptions of Goals/Objectives
Hierarchy of Objectives
Analysis Tool
Goal Analysis
Task Analysis

Figure 3. Inputs and Outputs of Common Analysis Activities.

An analysis phase is common to most instructional development models. Okey (1990) describes five analysis tools that are commonly used by instructional developers. As shown in Figure 3, the five tools described by Okey can be applied in a orderly sequence with the output of one analysis tool providing the input for the next. The final output of this traditional analysis sequence is a hierarchical organization of instructional objectives. This hierarchy of objectives is then used as a framework by instructional developers when developing instructional strategies and creating support materials.

The analysis tools described by Okey are very valuable in the development of instructional objectives but do not inform the developers about the social context in which the instructional product will be used. Adoption analysis can be used as an additional analysis tool for instructional developers who are concerned with the adoption and implementation of their products. The focus of adoption analysis is on the individual and organizational factors that could impede or facilitate the adoption and integration of a new technology.

Individual Factors

User Characteristics	Perceived Attributes
Motivation	Compatibility
Anxiety	Complexity
Knowledge Base	Observability
Prior Experience	Relative Advantage
Skill Level	Trialability

Organizational Factors

Physical Environment

Patterns of Use
Reasons for Use
Classroom Facilities
Management Characteristics
Existing Hardware & Software

Support Environment

Production Services
Storage / Delivery Services
Technical Support
Ongoing Monetary Support

Figure 4. Factors Affecting The Adoption Of An Instructional Product

The characteristics of the individuals who will ultimately use an instructional product can play an important role in whether or not the product is adopted. Farquhar and Surry (1994) define individual characteristics as "all of the skills, attitudes, perceptions, and knowledge possessed by the people who will use the technology." As shown in Figure 4, Individual Characteristics can be divided into the characteristics of the user population and the perceptions that the users have of the instructional product. This focus on perceptions is closely related to Burkman's User-Oriented Instructional Development Process.

In addition to individual factors, the characteristics of the organization into which an instructional product will be used often determine whether or not the product is adopted. Organizational factors (see Figure 4) include all of the personnel, expertise, attitudes, hardware, software, facilities, and services available within, or to, an organization. Organizational factors obviously play a major role in the initial adoption of an innovation but their most important role is likely in facilitating or hampering the continued use of an instructional product in the years after its initial adoption.

In conducting an adoption analysis, the instructional developer should seek to answer a series questions concerning the individual and organizational factors that might affect adoption of the product. Figure 5 lists several of the most important questions that can help to inform an adoption analysis.

Individual Factors

User Characteristics

What motivation do the users have for using this product?
Do the users have the necessary technical skills to use this product?
Do the users have special needs that this product should address?
Have the users used technology of this nature in the past?
Do the users have the knowledge base to use this product?

Perceived Attributes

Is this product compatible with the needs and culture of the users?
Is this product compatible with the users work or study schedule?
Is this product compatible with existing hardware and software?
Is the product perceived as too complex or too simple?
Is the product perceived as offering any advantages over previous or competing methods of instruction?
Do the users perceive that they will experience observable benefits from using this product?
Do the users perceive that they will be able to test or trial the product prior to full implementation?

Organizational Factors

Physical Environment

Where will the product be used?
How will the product be used in the daily operations of the organization?
Does the organization possess the hardware needed to use the product?
Does the organization possess the necessary labs and classroom spaces?
Who will install the product and any other complementary equipment?

Support Environment

Who will deliver, maintain, and administer the product?
Who will organize and deliver any needed follow-up training?
How will supplies be stored, ordered, paid for, and delivered?
Do key decision makers support or oppose the product?

Figure 5. Key Questions That Inform Adoption Analysis

While organizational and individual factors are the input needed to conduct an adoption analysis, an adoption plan is the output (see Figure 6). The adoption plan should specify the factors that will most likely facilitate or hamper the adoption and continued use of an instructional product. The plan should include specific design features that will make the instructional product more likely to be adopted and maintained. A simplified example is that if the adoption analysis determines that none of the workstations in an organization's training lab have CD ROM drives, then the instructional product should not be packaged in or require the use of CD ROMs.

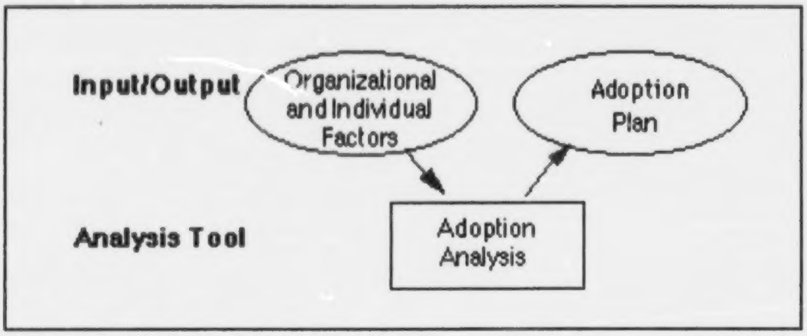

Figure 6. The Input and Output of an Adoption Analysis.

Recommendations

The theories of user oriented instructional development and adoption analysis have the potential to be powerful tools for instructional designers. It is possible that by incorporating these theories into the development process, instructional designers can develop products that are both instructionally effective and desirable to the people who are the intended users of the product. The following recommendations are provided in the hope that they will be incorporated into future ID projects:

1) Designers and developers of instructional technology should consider the adoption of their products as carefully as they consider the instructional effectiveness of their products.

Developing effective and efficient instructional products does not necessarily mean that the products are desirable or useful to potential adopters. The field of instructional development has made great breakthroughs in designing and developing effective instruction. Few breakthroughs have been made, however, in developing products that people want to use. One of the basic tenets of instructional technology is "if the objectives were not met, it means the instruction was not adequate." It seems odd, therefore, that when an instructional product is not adopted, instructional developers often blame the potential adopters. Another basic tenet of the field should be "if the product was not adopted, it means the design of the product did not adequately plan for adoption."

2) Designers and developers of instructional technology should incorporate the theories of user-oriented instructional development and adoption analysis into their instructional development models..

If instructional developers are to consider adoption of their products as carefully as they consider instructional effectiveness, then current models of instructional development will be insufficient for the task. Emerging theories that place an emphasis on the user and on the social context in which a product will be used can be incorporated into existing product development models.

3) Research should be undertaken to determine if incorporating user-centered instructional design and adoption analysis into instructional development models results in increased adoption and utilization.

The theories of user-oriented instructional development and adoption analysis have not been examined in practical settings. There is no published evidence to suggest that employing either of the theories will result in the increased adoption or facilitated implementation of an instructional product. Research into the effects of these theories is non-existent and urgently needed. Large-scale longitudinal studies that examine the impact and effectiveness of these theories on the adoption and continuation of instructional products would be very useful. However, since it is unlikely that either of these emerging theories is actually being used in large-scale development projects, case studies of smaller projects are a more likely research design.

Conclusion

It is not the intention of this paper to put forth a new model of instructional development. We agree with Gustafson's (1991) conclusions that "the literature is replete with models, each claiming to be unique and deserving of attention" (p.47) and "it appears that well over half of the ID models have never actually applied, never mind rigorously evaluated" (p. 47). The last thing the ID field needs is another untested design model claiming to be unique and valuable.

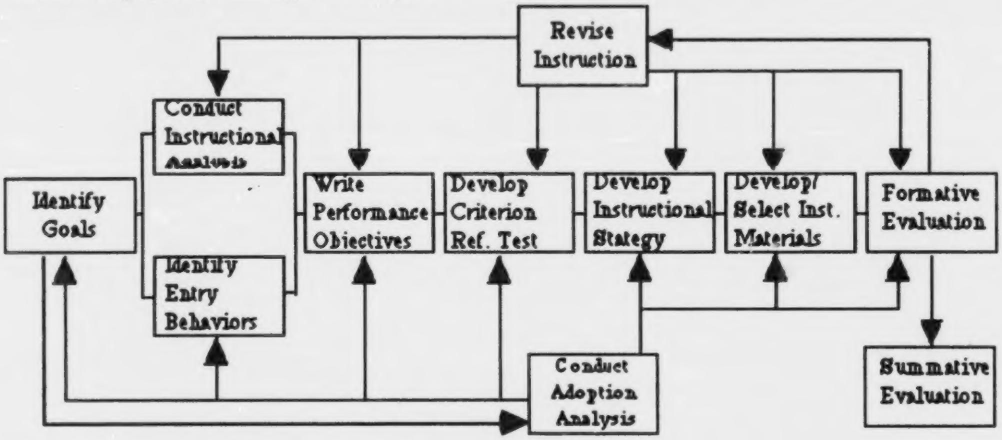
Revise Instruction
Conduct Instructional Analysis
Identify Goals
Identify Entry Behaviors
Write Performance Objectives
Develop Criterion Ref. Test
Develop Instructional Strategy
Develop/ Select Inst. Materials
Formative Evaluation
Conduct Adoption Analysis
Summative Evaluation

Figure 7. Incorporating adoption analysis into the Dick & Carey Model.

Instead of creating a new model, adoption analysis and a user-centered focus can be and should be incorporated into existing instructional development models. Figure 7 below shows how the theory of adoption analysis can be incorporated into the widely-used Dick & Carey Model. As shown in Figure 7, adoption analysis can easily incorporated into popular exiting ID models without radically altering them or detracting from their instructional effectiveness. As an example, in the Dick & Carey Model, after the goals of the project are determined, the project team could conduct an adoption analysis. The output of the analysis (an adoption plan) would specify the individual and organizational factors that might facilitate or impede the introduction of the product. This information could be used to modify the goals of the project or to inform key design decisions during each stage of the process.

Much more importantly than putting forth a new ID model, what is really needed is a new way of thinking. Instructional developers should consider the potential adoption and implementation of their products as carefully as they consider the instructional outcomes. Put another way, the value of an instructional product should be measured by the degree of adoption and the success of implementation just as much as it is now measured by cognitive and affective outcomes. In order for this to happen, instructional developers will have to analyze and account for the social context in which their products will be used. Also, developers will have to make adoption and dissemination important considerations of their design models throughout the entire ID process. Adoption analysis and user-oriented instructional development can be potentially valuable tools for instructional developers who agree that this new way of thinking is necessary.

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Title:

Design Considerations for Embedding Summary Writing Activities in CBI: Analysis of the Research

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Abstract

Summary writing is considered to be one of the power generative learning strategies. However, there is insufficient research to guide the design of summary writing activities in computer-based instruction. Examination of summary research suggests that variables such as learner characteristics, task condition and presentation features influence the effectiveness of summary writing in promoting meaningful learning. The paper attempts to identify research issues as well as design guidelines for embedding summary writing activities in computer-based instruction in these three areas.

How do instructional activities influence learning outcomes? According to cognitive theorists, there is a clear distinction between the role of the teacher and the role of the student in the learning process (Shuell,1988). The teacher's primary responsibility is to structure the learning activities in such a way that the students engage in the necessary information processing functions, and the student's responsibility is to carry out the functions. That is, instruction influences how students receive, process, and store information; it is then these student thought processes that directly mediate learning and achievement (Wittrock, 1986). For learning to occur, the critical functions of receiving, encoding, and retrieving must be performed by the student. Thus, researchers interested in improving the quality of instruction, including computer-based instruction, must focus on ways to help students engage in the critical thought processes that lead to effective learning. This paper will highlight research related to various issues of using summary writing as a learning strategy. The paper will also note potential research questions as well as instructional design recommendations based on the existing research.

Summary Writing

Summary writing is considered to be one of the power generative learning strategies (Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989). Summaries are defined as condensed statements that represent the gist or essence of the information available (Johnson, 1983). Researchers propose a variety of descriptions of the processes involved in summary writing. Most of these descriptions include at least the operations of selection and reduction (Brown & Day,1983; Hidi & Anderson, 1986). Johnson (1983), for example, suggests that there are six components to the generation of a summary: (a) comprehending the individual propositions, (b) establishing connections between propositions, (c) identifying the constituent structure, (d) remembering the information, (e) selecting the information to be presented in the summary, and (f) formulating a concise and coherent verbal representation of that information.

Many researchers argue that the ability to summarize is important for understanding and remembering text. Kintsch and van Dijk (1978) suggest that readers form a gist which represents their overall comprehension of the text while reading text. According to these authors, the reading process involves multiple, cyclical processing of propositions to arrive at macrostructures of the discourse using macrorules and generation of a gist of the discourse based on the macropropositions in memory, control schema, and general knowledge. Under this conception, summarizing becomes an integral component of comprehension.

Summary writing has traditionally been used as a way to assess recall and comprehension (Head, Readence, & Buss, 1989). More recently, however, researchers have proposed that the processes involved in summarizing can facilitate learning since they help learners clarify the meaning and significance of the new information (Brown, Campione, & Day, 1981; Hidi & Anderson, 1986). This new look at summary writing is consistent with the generative learning view of summary writing as an effective method for constructing meaningful relationships during learning (Wittrock, 1990). Whether summarizing is truly an automatic by-product of reading or not, summary writing as a generative activity makes these mental processes conscious. This mindful activity makes it possible for teachers to assess students' comprehension of the text, for students to monitor their own comprehension, and for students' learning to become more meaningful and memorable.

Effects of Summary Writing on Learning

Although there are many empirical studies of summary writing, a majority of them focus on effects of various treatments on students' summary writing ability. Relatively few studies are available to examine the effects of summarizing on learning.

Wittrock and Alessandrini (1990) studied the generation of summaries and analogies in light of students' analytical and holistic abilities. Fifty-seven undergraduate students were randomly assigned one of three treatments: read text, generate analogies, and generate summaries. All students read a 50-paragraph passage. For each of the fifty paragraphs, students were required to read and reread, generate an analogy, or generate a paraphrased summary. Analysis of student-generated analogies and summaries indicated that the two generation treatments induced the desired generative processing, and that summaries were somewhat easier to construct than analogies. Results on the posttest revealed that students in summary generation and in analogy generation groups learned significantly more than did students in the read only group. Analysis of time on task revealed that there was no significant difference in the amount of time spent learning the text.

Ross and Di Vesta (1976) studied the effects of oral summary activities on college students' retention. During the reading phase, 162 female undergraduate students independently read a passage and were given one of two kinds of learning instructions: students were told to read the passage or they were told prepare an oral summary from the reading. Pairs of students were then randomly assigned to one of three participation activities: present oral summary to partner, listen to oral summary of partner, or engage in neither activity during review. All students completed a multiple choice test and a delayed short-answer test . On measures of retention, results showed that the multiple-choice test scores for students who presented oral summaries and students who listened to oral summaries were significantly higher than those of students in the control condition. On the short-answer test, students who presented oral summaries performed significantly better than students who listened to summaries, who in turn performed significantly better than students in the control condition. Further analysis showed that the amount of time spent summarizing was highly correlated with summarizers' performance on both multiple choice and short answer measures. Overall, the authors concluded that subjects demonstrated a 25% advantage in retention after engaging in oral summaries, and a 13% advantage in retention after listening to partners' summaries over students who did not engage in any summary activity.

Design Considerations of Summary Writing Activities in CBI

Viewing summary writing as a generative activity requires that certain instructional design decisions be made regarding its effective use. In particular, learner characteristics, task conditions, and presentation features are expected to influence the effectiveness of summary writing activity in promoting meaningful learning.

Learner Variables

Research in aptitude-treatment interactions suggests that there are many learner characteristics that may influence the effectiveness of instructional strategies (Carrier & Jonassen, 1988). The most critical learner attribute in relation to generative learning activities is the learner's ability to carry out the mental processes required by the learning activity. Generative learning activities are more beneficial if students can engage in constructive mental processes without being distracted by the mechanics of generative task. Students' prior knowledge, age, and metacognitive potency are three learner characteristics that are closely related to their ability to benefit from summarizing (Jonassen, 1988).

Prior knowledge. Prior knowledge is perhaps the most relevant and strongest predicting factor in student learning (Kintsch, 1988; Tobias, 1987). Sufficient prior knowledge helps a reader arrive at the correct understanding of a text and reduces incorrect inferences. The perception of learning as a process of constructing meaningful relationships necessarily implies that learning must be built upon learners' existing knowledge. Sufficient prior knowledge is necessary for basic reading comprehension, for determining the relative importance of ideas, and for generating effective summaries.

Recht and Leslie (1988) investigated the effects of prior knowledge on short-term verbal and nonverbal memory and on long-term retention. Sixty-four junior high school students were classified as high or low reading ability and as possessing high or low level of prior knowledge about baseball. Each student read a story about a baseball game, used wooden figures to reenact the story, and verbally described the events. The student was then asked to summarize the story and sort random sentences into categories of high, medium, or low importance to the story. Results on the reenactment scores showed that memories of high knowledge students were significantly better than those of low knowledge students. Verbal retelling scores showed that high knowledge students recalled significantly more than low knowledge students. High knowledge students produced summaries that contained more correct information from the story, and were more like expert summaries than students with low knowledge. In addition, high knowledge students were more able to sort sentences into categories of high, medium, and low importance similar to those of experts than were low knowledge students. These results were similar for both high reading ability and low reading ability students.

In designing summarizing activities to enhance the quality of instruction, attention must be given to the available knowledge and experience levels of the learners. It is perhaps more beneficial to embed summary activities in school tasks that are a part of continuous curriculum units since these curriculum activities often build upon prior learning of the same content area than in artificial learning tasks.

Age and metacognition. Age and metacognitive awareness are two related characteristics that influence students' ability to carry out the mental processes required by summary writing tasks. As students gain more experience in academic tasks, they are likely to gain skills in carrying out certain generative learning tasks, and they are also like to benefit from metacognitive experiences.

Garner (1985) investigated older students' ability to summarize text. One hundred and twenty ninth-grade, eleventh-grade and college students were asked to produce an optimal and a poor summary for a three-page general science article. Student summaries were scored on the number of important ideas included and succinctness. On the number of important ideas included in summaries, results showed that high school and college students were aware that important ideas from a descriptive passage should be included in a short summary of the passage. Seventy-three percent of all the students differentiated optimal and poor summaries by including more judged-important ideas in the optimal summaries, although college students showed higher awareness than high school students. College students were more capable of actually including important ideas in their optimal summaries than high school students. The author concludes that high school and college students are well awareness that important ideas should be included in summaries, and that this awareness is matched by an ability to actually include the important ideas in summaries in college students but not in high school students. On measures of succinctness, however, both high school and college students were significantly less aware and less capable.

Brown, Day, and Jones (1983) studied younger and older students' use of planning strategies in generating written summaries. Fifty-seven students in fifth-grade, seventh-grade, eleventh-grade and college learned two folk stories to criterion. The students were then asked to summarize one of the stories from memory three times: unrestricted, in 40 words, and in 20 words. Student summaries were rated on three measures: number of important ideas included, amount of verbatim information, and evidence of planning. On the number of important ideas included in summaries, seventh and eleventh-graders and college students exhibited similar patterns in including important idea units in their summaries, but college students showed greater efficiency at including more idea units in fewer words. Analyses of the unrestricted summaries and the 40-word summaries showed that seventh and eleventh grade students and college students did not differ in including important ideas in their summaries; all groups outperformed fifth-grade students. In the 20-word summaries, college students outperformed fifth, seventh, and eleventh grade students in including important idea units in their summaries. On amount of verbatim information, fifth and seventh graders produced more verbatim summaries while the majority of the eleventh graders and college students wrote summaries in their own words. On evidence of planning, young students tended to run out of space and could not include important ideas from the second half of the stories due to lack of planning. Overall, significantly more eleventh graders and college students exhibited spontaneous planning behaviors than did fifth and seventh graders.

It seems that without extensive strategy training, summarizing as a learning mechanism is more beneficial for older students than for younger students.

Task Conditions

The nature of the summary writing condition can be expected to mediate the quality of the summaries produced (Hidi & Anderson, 1986; Johnson, 1983). To the extent that these conditions influence the cognitive operations of the summarizer, they will influence the effects on learning outcomes. Four such conditions are 1) the availability of the lesson content during summarizing, 2) the frequency of summary activities within a lesson, 3) type of summary required, and 4) the presentation features of the lesson.

Availability of the lesson content while summarizing. Hidi and Anderson (1986) propose that if students are able to scan the material repeatedly during summarizing, the demands on the short-term memory are reduced, and there are more cognitive resources available for other operations such as making fine discriminations about the importance of ideas in the text, clarifying inconsistencies, and chunking larger text units. Therefore, the tasks of discrimination, comparison, inference, structure assembly, and writing can be performed more deliberately. More importantly, the summarizer can repeatedly check the production of the summary against the lesson content for accuracy.

On the other hand, when students must summarize from memory, these processes are given different priorities, assuming that students have not completely memorized the content first. The process of scanning is limited to retrieving available memory traces of the text. The tasks of discrimination, comparison, and inferencing are also more restrained to more important information because readers are more likely to remember important information than trivial information (Mandler & Johnson, 1977; van den Broek, 1988). Similarly, processes of reorganization and summary generation must rely heavily on idiosyncratic schemata rather than on the text itself. When the propositions are recalled from memory to be summarized, they are more likely to appear in forms of personally relevant relationships than verbatim information from the original text. Students' mental operations can be expected to draw heavily on the relation between the new information and the learner's own experience and knowledge, and can be expected to strengthen and stabilize those relationships.

Empirical evidence that examines the variable of text availability is limited. Hidi (reported in Hidi & Anderson, 1986) reports ambiguous results comparing summarizing under text-present and text-absent conditions in two studies. In the first experiment, students were divided into two groups: text-present (summarize text while looking at text), and text-absent (summarize text from memory). Results showed that although the summaries produced in the two groups were similar, the text-absent condition led to higher recall scores than the text-present condition one week after the treatment. As expected, student summaries in the text-absent group were more likely to deviate from the original text and combine propositions. However, these results were not replicated in the second experiment.

Stein and Kirby (1992) studied the effects of text presence on students' summarizing and recall. Sixth-grade students summarized a passage under one of two conditions: text present or text absent. Students were then asked to provide oral free recalls of the passage. Student summaries were scored on amount of information included, the ratio of the number of important propositions over the total number of propositions in the summaries, and on the degree of non-verbatim integration of the ideas in the summaries. Student recalls were scored for amount of information included. Results were mixed. Specifically, the text-absent condition resulted in more integrative summaries for more able readers, but not for less able readers. Also, the amount of information included in summaries had a strong effect on recall, above reading ability, for the text-absent group. The text-present condition led to higher recall scores than did the text absent condition, regardless of reading ability levels. Reading ability and depth of integration in summaries, not number of propositions included in summaries, predicted recall performance in the text-present condition.

Tsai, Simsek, and Johnson (1993) studied the effects of text presence on students' summary production and comprehension during a computer-based tutorial. Fifty-two high school students enrolled in a math course studied a computer tutorial and were asked to produce three on-line summaries as they progressed in the lesson. The students were randomly assigned to one of four treatments: a) text-present underlining, b) text-present no underlining, c) text-absent underlining, and d) text-absent no underlining. In the two text-present conditions, students were allowed to review the lesson segment while attempting to summarize it. In the two text-absent conditions, students were informed that once they began writing summaries, they would not be able to review the lesson segment. In the two underlining conditions, students received the instruction with the important phrases underlined. In the two no-underlining conditions, important lesson information was not underlined. Student summaries were analyzed for number of words, number of important ideas, and number of extraneous ideas. Students completed an attitude survey and a short-answer post-test. Results showed that underlining important information for the students led to significantly longer study time and significantly higher post-test scores than the no-underlining conditions. However, being able to review the lesson while summarizing it did not help students produce significantly better summaries and did not lead to significantly higher post-test scores than students in the text-absent conditions.

Tsai (1994) examined the effect of lesson availability in a similar study. High school students studying complex computer-based biology lessons were randomly assigned to several summary-reading and summary-writing treatments. Students who were assigned to "summary writing from memory" conditions studied the lessons one section at a time, and when they indicated that they were ready to summarize the section, they were not allowed to review the section's content while they wrote the summary using paper-pencil work sheets. Students who were assigned to "summary writing with review" also studied the lessons one section at a time. When they indicated that they were ready to summarize each section, they were given the choice of reviewing the content while writing the summary using paper and pencil work sheets. The students' summaries were scored for number of words produced, and the number of independent clauses produced that matched expert summaries. Students also completed a multiple-choice test, a short-answer test, and an attitude survey. Results showed that students who were given access to the lesson while summarizing it produced longer summaries and included more ideas that matched expert summaries. Correlation analysis showed that summary length and number of matching ideas in the summaries were highly correlated to students' performance on the achievement tests. However, the treatment did not directly affect achievement, attitude or learning time.

Research in a related areas such as adjunct questioning and inference verification also provides ambiguous results. Hayes-Roth and Walker (1979) studied the effects of text availability on students' ability to verify inferences. Eight undergraduate students studied four pairs of text passages under two conditions. In the text condition, students read the passages before completing an inference verification test. They were encouraged to review portions of the texts while trying to judge whether the inferences were true or false. In the memory condition, students were asked to read the passages very carefully, and were asked to complete adjunct questions on arbitrary information in the texts to maximize learning from the texts. They were then asked to complete the inference verification test without referring back to the texts. All students were asked to justify their reasoning for their answers while completing the inference test. Performance on the inference verification test showed no significant difference between the text and memory conditions. However, on the accuracy of students' justification of true inferences showed that the proportion of correctly justified true inferences was significantly higher in the memory condition than in the text condition. Further analyses of students' verbal protocols indicated that students in the memory condition were more able to identify the critical facts underlying true inferences than students in the text condition.

In conclusion, there is sufficient evidence to suggest that access to text during summarizing mediates the quality of the summaries. However, there is limited evidence about how this influences the quality of learning. Theoretical speculation and the limited research evidence suggest that summarizing from memory may facilitate long-term retention of the lesson content. A concern not addressed in the existing research is how students actually use the opportunity to review text as they summarize. In a computer-based learning environment, this information can be tracked, and it may provide additional insight to how availability of lesson content can mediate summarizing and learning.

Frequency of summarizing. Frequency of summarizing refers to the number of noncumulative summaries required for a given amount of lesson content. It is related to the amount of information to be summarized in each summary. Current understanding of the spatial and temporal limitations of the short-term memory suggests that longer segments are more difficult to summarize than shorter ones. Hidi and Anderson (1986) suggest that shorter segments are likely to contain fewer ideas and ideas which are closely related, and place relatively less processing demands on students' short-term memory during summarizing than long segments. Exactly how this variable affects learning, however, is unclear.

Spurlin, Dansereau, O'Donnell, and Brooks (1988) had 48 undergraduate students summarize a passage. Students were randomly assigned to one of three conditions: produce frequent noncumulative summaries at equally spaced intervals throughout the passage, produce infrequent summaries, or simply read the passage. All students completed a delayed test requiring them to write a well-organized essay reflecting what they had read five days after the treatment. The essays were measured on amount of recall and overall organization. Analyses of student summaries showed that students in the frequent summarizing group wrote more complete summaries than students in the infrequent summarizing group. However, on both amount of recall and overall organization of the post-reading essay test, only the infrequent summarizing group significantly outperformed the control group.

Germane (1921) studied the effects of written paragraph summaries on students' learning of science texts. Nine hundred sixth-, seventh-, and eighth-grade students were randomly assigned to summarizing group or re-reading group while studying two science articles. Students in the summarizing group were first taught how to summarize two sample paragraphs. Then for each article, students were asked to read carefully and summarize each paragraph. A specific time restriction was enforced. Students in the re-reading group were asked to read the article as many times as they could within the same time limit. Immediate and delayed free recall tests were given. Results showed that the re-reading group performed significantly better on both the immediate and the delayed recall tests. These results held true for questions that addressed main ideas and minor ideas in the articles. The author speculated that the summarizing group was handicapped by the method of summarizing each paragraph since the students seemed to have a large number of isolated facts but failed to see the relationship and grasp the article in its entirety.

Tsai (1994) in the study mentioned earlier, randomly assigned high school students to Frequent or Infrequent summary activities while they studied complex biology lessons using computer-based lessons. Students who were assigned to the Frequent treatments were required to read or write summaries for each content topic of the lessons. These students wrote a total of 12 summaries while studying two lessons. Students who were assigned to the Infrequent treatments were required to read or write summaries for each major content unit of the lessons. These students wrote a total of 4 summaries while studying the two lessons. Results showed that students who participated in frequent summary-writing activities wrote significantly more words in total than students who participated in infrequent summary-writing activities. Again, summary length was highly correlated with performance on achievement tests even though the treatment itself did not directly lead to significant differences in achievement or time.

There are three reasons that summarizing relatively longer lesson segments may have positive effects on learning and retention. First, students who summarize infrequently are expected to extend more recall effort than do students in frequent summarizing group, and the increased effort may lead to more effective delayed recall. Second, students are more likely to encode and retrieve meanings and relationships than isolated facts. When students summarize large chunks of content, they must identify the relationships among various concepts in the lesson whereas summarizing short segments of content may force them to focus on isolated concepts. Third, the mechanics of frequent activities may distract learners' attention from the content of the lesson. When students are only required to summarize infrequently, they are more likely to adopt text studying, not summarizing, as the primary task.

In conclusion, the frequency of summarizing within a lesson is expected to mediate summary production and learning. Limited empirical evidence suggests that the shorter a lesson segment the easier it is to summarize. However, there is also reason to speculate that summarizing longer lesson segments may be more beneficial for learning. Clearly this issue needs further examination.

Type of summary reuqired. Researchers have utilized a variety of types of summaries to facilitate learning. Taylor and Beach (1984), for example, taught students to recognize and use the existing textual structure to guide their summary production. Wittrock and Alessandrini (1990) and Tsai (1994) required students to summarize "in their own words." Brown, Day, and Jones (1983) required students to first learn the text "to criterion," and then to produce summaries according to various length constraints. In the Ross and Di Vesta (1976) study and the Recht and Leslie (1988) study mentioned earlier, students were required to produce oral summaries of the material.

Hidi and Anderson (1986) proposed that there is a difference between producing a "reader-based" summary and producing a "writer-based" summary. Reader-based summaries place significant emphasis on proper planning (Brown, Day, & Jones, 1983) as well as effective grammar and prose structure skills. The purpose of the reader-based summaries is to present an effective communication of the orginal material to others. Writer-based summaries, on the other hand, primarily serves the producers of the summaries to help them condense the information for their own use. Writer-based summaries place much less emphasis on the structure of the writing, and more emphasis on the usefulness of the content for the summary writers. Hidi and Anderson (1986) thus suggest that writer-based summary writing is more efficient as a learning strategy than reader-based summary writing. Although this proposition seems logical, there is little empirical evidence so far to demonstrate the relative learning value of these two types of summaries.

Presentation Feature Manipulations. Presenting stimuli with distinctive features has long been a prescribed strategy for instructional designers to help students focus attention on important information (Gagne, Briggs, & Wager, 1988; Wager & Gagne, 1988). This prescription is driven by the understanding that students have limited short-term memory capacity, and instructional events must take advantage of selective perception. The underlining strategy is widely used to highlight information for students who may not be sensitive to its importance. It is an effective tool to cue the students' attention which in turn results in better retention of that information.

Philosophically agreeable or not, successful students are often those who are able to recognize as important the ideas that their teachers also consider important. Many researchers believe that students fail to grasp the important information while studying. This is often cited as a major obstacle to successful use of effective learning strategies (Anderson & Armbruster, 1984; Winograd & Bridge, 1986). It may be necessary to direct students' attention to important information so that they benefit from generative learning strategies more efficiently.

In the Tsai, Simsek and Johnson study cited earlier (1993), students who studied the computer-based tutorial with important information underlined tended to include more important ideas than students who were not aided by the underlining, although the differences were not significant. However, the underlining treatments led to significantly higher post-test scores.

Garner and McCaleb (1985) studied the effects of cueing, organization, and reduction constraints on undergraduate students' summary production. The cueing variable included 3 treatments: a) no cueing, b) explicit topic sentences, and c) signal words such as "important" embedded in the topic sentences. Two levels of organization were used: a) all important ideas were presented together, and b) important ideas were distributed among the paragraphs. Two levels of reduction constraints were studied: a) three-sentence summary, and b) seven-sentence summary. Students read a seven-paragraph science text in one of the treatments and wrote summaries. Student summaries were scored for number of words, number of important ideas, evidence of deviation in order of information, and evidence of integration. Results suggested that cueing had a significant effect on summary scores. Specifically, both cueing treatments led to significantly higher number of important ideas in student summaries than no cueing, with no significant difference between the two cueing conditions. Also, both cueing treatments produced significantly more integration of ideas in student summaries than no cueing, again with no significant difference between the two cueing groups.

It is arguable that the very strategy of highlighting important information may interfere with students' construction of personally relevant relationships out of the instructional information. The processes of integrating the information and selecting important ideas may be reduced to a more mechanical process of locating cued phrases in the text. Nevertheless, the results hold significant promises for the instructional designer. It seems possible that simple manipulations of text features can significantly increase the effective use of complex learning strategies such as summarization. The reality of educational practices is that students are often evaluated against what instructional designers, teachers, and other experts believe to be important. Thus, a pragmatic task of designing instruction is to engage students in effective generative activities in order to learn what is considered important. To this end, simple attention focusing strategies such as underlining important phrases may enhance the learning outcome of summary writing activities.

Instructional Design recommendations

Several instructional design guidelines can be drawn from the research evidence in this area. These recommendations focus primarily on designing the summary writing activities to accommodate learner characteristics to reduce unnecessary demands on the learner while using summarization as a learning tool.

1) Summary writing strategy can generally be reliably used with students who are older, have more sophisticated metacognitive control, or possess high levels of prior knowledg.

2) The teacher or instructional designer may first test to make sure that students are able to perform the mechanics required by the summary writing task with relative ease.

3) Highlight important information for students to guide their summaries, especially for complex content, and for students with low prior knowledge or low language who are less able to differentiate between important and not-important information

4) For learners with limited experience writing summaries, provide structure in the summary writing activities to make this a productive learning tool. Provide structure and prompts (such as "look for the topic sentence, look for the support idea, do not include repetitive examples..."). Encourage students to provide oral summaries if writing is a significant challenge for them.

5) Use summary writing activities for curriculum topics that build upon each other so that students can draw on their knowledge of previous topics to write effective summaries.

6) Encourage "writer-based summaries" to reduce the demand on writing skills, and to promote summary-writing as a learning tool. Encourage students to make their summaries personally meaningful. As Stein and Kirby (1992) found, depth of integration in students' summaries may be an important predictor of depth of learning.

7) Avoid using length constraints. Length constaints tend to require careful planning and editing which may distract from learning of the content.

8) Allow students to review the lesson while summarizing it. To make this a useful option, encourage students to check the accuracy of their summaries during such reviews. Also, help students develop the strategy of monitoring their comprehension through such reviews.

9) Allow for frequent summary writing activities (Tsai, 1994), but avoid making summary writing the predominant task which may distract from learning (Germane, 1921).

Further Research Issues

Based on the above findings, several research issues are worth exploring.

1) It is clear that learner characteristics have a strong impact on the effective use of summary writing strategy in learning. It would be helpful for the instructional designer to have a clearer set of algorithm in selecting the key learner characteristics to be studied and designing the most appropriate summary activities. Work in mathemagenic and generative learning strategies by researchers such as Pat Smith promises to provide some clarification in this area.

2) What is the best way to predict the appropriate frequency of summary writing activities? It seems that learner characteristics, complexity of materials, and desired learning outcome are important considerations. But the guidelines for making such determination should be derived from empirical evidence.

3) The variable of availability of lesson during summarization needs further study. There are at least three questions regarding this variable. First, what kind of summaries tend to be produced? There is contradicting evidence so far on the effects of this variable on summary production. One of the proposed outcome of summarizing from memory is that students integrate more information into their personal schemata than if if they simply copy the information from the original lesson.

Second question: what is the impact on different kinds of learning? It has been hypothsized that students who summarize from memory will produce more integrated summaries, and will demonstrate a higher level of increase in their capability to analyze and synthesize the information than students who scanned the lesson frequently during summarization. Clarification from empirical evidence in this area will guide the instructional designer in determining the appropriate strategies.

Third question: what strategies do students use to write summaries? Tsai (1994) suggested summarizing from memory is an unfamiliar task for many students, and that they must learn the strategy of studying the lesson more carefully before beginning their summary writing. In addition, Tsai (1994) suggested that when students do have the option of reviewing the lesson while summarizing it, it is unclear how they actually use that option. If they do not review the lesson to increase the accuracy of their summaries, then this option is not necessary. Thus, examination of student behaviors under different conditions of this variable will be helpful in designing the appropriate summary activities.

4) The effects of writer-based and reader-based summaries should be examined. Hidi and Anderson (1986) would propose that for learning purposes writer-based summaries are more efficient and preferrable to reader-based summaries. It could be argued, however, that the process of planning and structuring a "good" reader-based summary is highly beneficial to learning, especially for people who believe that "the best way to learn a topic is to teach it." Thus the question of "is writer-based summary writing more efficient and beneficial" should be studied. Related to this question is the need to examine whether summary length constraints enhance or reduce efficiency of learning for the strategy of summary writing.

Conclusion

Embedding generative learning activities in CBI courseware has been recommended for promoting deep processing in CBI (Jonassen, 1988). However, it is important that instructional design decisions for these activities are informed by sound theoretical and empirical evidence. This paper focused on one of the more powerful generative learning activities, namely, summary writing. It reviewed current understanding of the mental processes involved in generating summaries, and examined instructional design variables that are believed to mediate summary production and its effects on learning.

The mental processes involved in producing summaries -- such processes as scanning information, comparing information for importance, and reorganizing the important information into a coherent format -- promote deep processing. These processes also provide an opportunity to strengthen the conceptual relationships that the learner may have subconsciously constructed during learning. There is convincing evidence that summary writing activities can facilitate student learning. However, many instructional design decisions regarding the effective use of summarizing have not been resolved. Specifically, limited evidence is available to determine whether it is more beneficial to require students to summarize from memory than to summarize while reviewing the lesson content. It is unclear how the frequency of summary activities within a given lesson affects summary production and its effects on learning. In addition, we need to further study the impact of highlighting information on the effectiveness of summary writing activities. Research in these areas can provide insights into the mental processes of summarizing as well as useful guidelines for instructional designers in designing effective summarizing activities.

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Title:

Instructional Format And Segment Length In Interactive Video Programs

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Abstract

An experiment is reported in which subjects worked with an interactive videodisk program about cheese making on the basis of the same set of instructional objectives but in different experimental conditions with respect to learner control. The purpose of the study was to investigate the relationship between learner-controlled or program-controlled length of video segments and test performance on post-tests and retention tests. Also, differences between self-chosen and program-controlled segment length regarding the investment of mental effort of subjects were examined. The results show that long program-controlled video segments have some advantage over interactive video when learning factual information. However, well-designed interactive video applications may offer a comfortable work environment that allows for a relaxed use of mental effort. The results of the experiment seem to suggest that video segments with a length of about 3 minutes, containing enough factual information for answering 8 or 9 questions, may appear to be optimal building blocks. Subsequent experiments should reveal to what extent this suggestion is valid.

Introduction

Verhagen (1992a, 1992b) undertook a study to gather insight about the length of segments in interactive video programs on the basis of the following central question:

What is the optimum length of well-designed audio-visual segments to present factual information via an interactive video program to learners who possess certain characteristics?

In his study, five experimental conditions were used in an attempt to answer eleven more elaborate research questions. The study was carried out with a specially produced videodisk program about cheese making. This program contains 252 information elements which form a connected discourse of 36 minutes if the program is played linearly without stopping. An information element is defined as one uninterrupted statement of the off-screen narrator about which one factual question can be put. In two conditions, subjects could choose segment length for themselves by interrupting the video presentation anytime they wanted. In the other three conditions, fixed segment lengths were used to study recall differences with self-chosen segment length. Subjects were 235 first-year students of several technical and social science departments at a single university in the Netherlands.

Verhagen's experiment was essentially a memory experiment in which the program was used to find out what segment lengths are preferred by learners. Each subject worked individually with the program.

The results showed self-chosen segment lengths of which the means per subject varied from 2.19 to 87.50 information elements (which is in time a range from about 16 seconds to 11 minutes). The mean of mean length was 12.70 information elements (which equals about 1.7 minutes) with a standard deviation of 11.77 information elements. Details are reported by Verhagen (1992a, 1992b).

The longer the video segments were, the lower was, on average, the recall of factual information when answering questions directly after watching a segment. The differences between self-chosen segment lengths and fixed segment lengths appeared thereby to be small with the exception of the so-called Linear Condition. The Linear Condition is a fixed-length condition in which the subjects are forced to watch the whole program without stopping. In this condition, the direct-recall performance was substantially lower (54% correct answers) than in any of the other conditions (around 80% correct answers).

After three weeks, delayed recall was measured with a retention test. In this case, subjects of the Linear Condition performed equally well or better than all others while on average questions about long fixed segments were answered better than questions about short fixed segments. The questions about the long fixed segments often also yielded a better performance than the retention scores of subjects who worked with self-chosen long segment lengths. Inspired by work of Salomon (1984) and of Cennamo, Savenye, & Smith (1991), Verhagen (1993) argues that the success of the longer segments may be attributed to larger amounts of invested mental effort (AIME) due to perceived more difficult demand characteristics (PDC's) of the expected longer segments.

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Rules about what to regard as 'optimal' when deciding on segment length did not emerge. The findings gave, nevertheless, reasons to formulate a few tentative guidelines for the design of segments. The guidelines that are relevant for the present study are as follows:

"If factual information is presented to university freshmen and a systematic presentation with off-screen narration is used, a wide variety of segment lengths is feasible. If a safe range is sought in which initial remembering is to reach at least 70%, segment lengths up to 22 information elements are appropriate. Using the condensed presentation rate of the experimental video program used in the study, up to about 3 minutes of presentation time can be used." (Verhagen, 1992b, p.260)

"For optimal remembering, learners should be strongly urged to invest substantial mental effort. This deepens the initial processing, which enhances long-term storage of the information. Choosing long fixed segments helps, but if the information load goes beyond the ability of the learners they may find the task unpleasant. On the other hand, segments that are too short may be so easy that learners are not compelled to invest effort, and thus hamper adequate storage into memory." (Verhagen, 1992b, p.260-261)

Need for further study

The results in Verhagen's study were obtained through an experimental procedure that follows a pattern of presenting video, asking questions, and giving feedback and remediation. This basic pattern has been used by other researchers who studied interactive video in instruction experiments such as Schaffer and Hannafin (1986), Phillips, Hannafin, and Tripp (1988), and Cennamo, Savenye, and Smith (1991). The procedure can be considered as sufficiently similar to real patterns of instruction to make it possible, in principle, to reach conclusions with respect to segment length, based on the results of the experiments, that can be generalised to rules for the design of segments for instructional interactive video programs. An unsatisfactory aspect of the reported results is, however, that they were obtained in a memory experiment. The performance required did not serve any instructional purpose. The subjects were just expected to recall every factual statement as presented by the program, although literal answers were not necessary (answers to questions that showed understanding of the information that was presented by the pertaining videodisk fragment were rated to be correct). The observed segment lengths may, therefore, not represent the kind of segment lengths that are effective in instructional applications. Looking at other experiments, an obvious difference concerns the information load per segment as expressed in the amount of questions that are presented about the content of each segment. Schaffer and Hannafin (1986), for instance, worked with a video program of $13^2/3$ minutes that was subdivided into five segments. The mean segment length of their program is 2.75 minutes. The information load per segment was substantially less than in the dense-packed videodisk program on cheese making. Learners had to answer only three questions per segment instead of the 22 questions per segment in the case of segments of 3 minutes in Verhagen's experiment.

Schaffer and Hannafin carried out their experiment with ninth-through-twelfth graders. In the experiment, the amount and type of interactivity was varied in four conditions. The least interactive condition was similar to the Linear Condition of Verhagen's experiment: just presenting the video program without interruption. In the most interactive condition, next to the five video segments, questions, feedback and video branching were components of the interactive structure. Schaffer and Hannafin used a measure that they called "Acquisition Rate". Acquisition Rate was derived based upon the ratio of recall and instructional time. Schaffer and Hannafin found that: "The fully interactive version yielded the greatest recall but took longer to complete than any of the other presentations. Time was shortest, and the resulting rate of learning was greatest, for the simple linear video presentation" (Schaffer and Hannafin, 1986, p. 89). Schaffer and Hannafin concluded that the efficiency of interactive video for teaching factual content may be questionable. This result seems to show similarities with Verhagen's results, specifically with the relative success of his Linear Condition.

Maccoby and Sheffield (1961), and Margolius and Sheffield (1961) used a film of 18 minutes to carry out a series of studies about segment length and the learning of a mechanical-assembly task. They introduced the idea of "demonstration-assimilation span" (DA-span) which defines a kind of stopping point: "which comes at a point when the learner has assimilated about as much demonstration material as he can hold in his mind well enough to translate into overt practice with little or no error" (Maccoby & Sheffield, 1961, p. 79). Maccoby and Sheffield and also Margolius and Sheffield (1961) used fixed segment lengths. A DA-span segment was defined as a segment which could be practised with a mean group-performance score of about 75 per cent correctly responding immediately after viewing. The length of the segments differed considerably, as the DA-span was determined by how much the student could assimilate in one stretch. One of the four sections of the 18-minute film had a running time of six minutes, whereas another section, a more difficult one, ran only 2.5 minutes, while both were considered to have a similar DA-span for the given target group.

The interpretation of Anderson and Faust (1975, p. 215) of the work by Sheffield and his associates was that the experiments demonstrated "that short presentations followed by short periods of practice are more effective than longer presentations followed by longer periods of practice". They concluded that: "in summary, experimental evidence seems to indicate that students learn more when required to make active responses immediately after small segments of a lesson" (Anderson & Faust, 1975, p. 216).

The tasks in these experiments were very different from just learning factual information. Students practised the assembly task with concrete parts in their hands and cues from parts already assembled or still on the table. The order of magnitude of the used segment lengths for the assembly task is, nevertheless, rather similar to the segment lengths from the studies by Verhagen and by Schaffer and Hannafin. Although the experimental procedures showed similarities, differences in the tasks, content, and target groups make it impossible to support the validity of Verhagen's first guideline.

This conclusion is reinforced by a study by Weiss, Maccoby, and Sheffield (1961) in which very different segment lengths were in use. Weiss, Maccoby, and Sheffield applied the same research methodology that was used for the assembly task to serial learning of a geometric-construction task. This time a film of 4.5 minutes was used that demonstrated the nine-step construction of a five-sided equilateral polygon, using pencil and paper and a straight-edge and compass. The film consisted of six DA-span segments. The longest DA-span segment in this film was 75 seconds in length, the shortest segment was 12 seconds. They concluded that "the DA-span unit, as the practice unit, uniformly gives superior performance during practice but is not guaranteed to connect together the different parts of the total task. A compromise which gives at least some practice at larger units of the task may be desirable even if it entails more errors in performance at the out-set of practice." (Weiss, Maccoby, & Sheffield, 1961, p. 76)

In the geometry task, all subsequent steps had to be recalled. This requirement resembles more the subject of the other studies mentioned. However, the used segment length were very different. Not much advice can thus be derived from the different experiments about what segment length should be preferred for presenting factual information, possibly with the exception that segments that are too short may hinder the integration of information into one organised whole (Weiss, Maccoby, & Sheffield, 1961). It is, in other words, not clear whether for factual information some frequently alternating presentation-and-practice format should be developed (which complies with the conclusion of Anderson & Faust, 1975) or whether Webb's notion that lengthy films can teach well (Webb, 1975), and may yield a relative efficient learning situation (Schaffer and Hannafin, 1986), should guide designers.

Research questions

The research that is reported here, was designed to gather further insight into that matter and was specifically designed to find out whether the conclusions of Verhagen's study should be altered if data collection is carried out in an instruction experiment instead of in a memory experiment. The second guideline is also involved. Verhagen's contention that the success of the longer segments may be attributed to larger amounts of invested mental effort (AIME), was reached through secondary analysis of his data. In his experiments, no measurement of AIME had been done. In the experiment that is reported here, the study of the effect of AIME is included.

To be able to observe differences with the earlier study, the same videodisk about cheese making is used. The research is undertaken to attempt to answer the next three research questions:

Question 1:

Given an experimental videodisk containing 252 information elements, does self-chosen segment length differ if recall of factual information is not required as an exercise in memory performance with regard to the content of individual information elements but as evidence of reaching explicitly stated instructional objectives concerning the program as a whole?

Question 2:
What differences can be observed between self-chosen and program-controlled segment length regarding the investment of mental effort of subjects?
Question 3:
How do the differences of Question 2 relate to performance on post-tests and retention tests?

Instructional format

The instructional format that had to be developed for the experiments was not very different from the procedure of the earlier experiment. The basic pattern of watching video segments, answering embedded questions and getting feedback on the answers is an appropriate strategy to get active and learning learners, as is demonstrated by research of, for instance, Schaffer and Hannafin (1986), Phillips, Hannafin, and Tripp (1988), and Cennamo, Savenye and Smith (1991). The difference is that the content of the videodisk is analysed to serve a realistic instructional purpose for which clear instructional objectives are formulated. The orientation of the learners takes place on the basis of the objectives and the number of questions have been adjusted to the to-be-learned factual knowledge according to the objectives. The total number of embedded questions in the measuring section of the new version of the program is 97, which is substantially less than the 213 questions in the measuring section of the memory experiment.

The orientation of learners by the use of objectives is a recommended pre-instructional strategy before presenting audio-visual material, as are pre-tests and overviews (Morrison, 1979). The instructional format has been shaped accordingly. A list of objectives was made available to the learners which they were required to study before working with the interactive video program. A pre-test is introduced in the experimental procedure. The control of the program is organised by a menu structure that provides an overview of treated subjects (Figure 1b). This approach is taken despite results by Phillips, Hannafin, and Tripp (1988) who show that cueing by orienting learners with introductory statements before working through video segments is not a very successful way. In their experiment orienting activities of this kind accounted for less than 3% of the variance of post-test scores, while their findings also suggested that cueing by practice is an appropriate strategy. The use of embedded questions may thereby serve as a cueing strategy. In the experiment this kind of cueing is provided also. The orienting activities are not excluded, however, because other research does support Morrison's recommendations. Tovar and Coldevin (1992), for instance, found that the provision of orienting activities in the form of a list of criteria for carrying out a certain procedure, a slide presentation of all the tools used in this procedure, and a flow chart showing the steps of the procedure, significantly facilitated the recall of factual information from an interactive videodisk lesson.

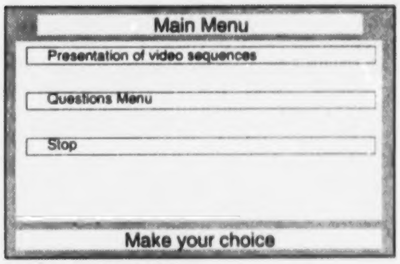
The experimental program

The videodisk program that was used for the study was the same program that was used in Verhagen's experiments. The 252 information elements of this program were divided into two sections. The first 33 information elements form an introduction to familiarise the subjects with the experimental procedure, the remaining 219 information elements form the main program which was used for data collection. In time, the introduction has a length of 4.5 minutes and the main program has a duration of 31.5 minutes. The controlling computer program ensures that the video program can only be started or stopped between two information elements. This causes video segments of the program always to consist of whole numbers of information elements. This mechanism was applied in Verhagen's experiments (Verhagen, 1992a, 1992b) and is maintained in the present study. In the experimental conditions that were developed for the present study, however, the last three information elements of the videodisk program are not used. They provide a not-content-related ending of the linear program that has no function in the menu-driven organisation of the new conditions that are described below.

In the main condition for the present experiment, the measuring section was structured according to the following menu structure: At the top level of the program, the Main Menu, the subject could choose between the presentation of video sequences or the presentation of questions related to the different sequences (the Main Menu is presented in Figure 1a).

In the Video-Sequence Menu, presented in Figure 1b, the subject could choose one of seven sequences. Once chosen, the video started playing. The subject watched the sequence until he/she decided - for whatever reason - that it was time to command stopping by pushing a mouse button. The program consequently stopped at the end of the information element in which the stopping was requested. Then a menu was presented (Figure 1d) in which the subject could choose to go on with the presentation, to answer questions or to return to the Video-Sequence Menu (Figure 1b). If the subject chose to answer questions he/she was presented a menu (Figure 1e) in which the subject could choose to answer questions about the segment he/she just watched, to answer questions about the entire sequence or to return to the last menu (Figure 1d). At the end of a sequence the subject was presented a menu (Figure 1f) in which the subject could choose to repeat the sequence, to go to the next sequence, to answer questions or to return to the Video-Sequence Menu. If the option to answer questions was chosen, a menu was presented (Figure 1g) in which the subject had options to answer questions about the last segment he/she watched, answer questions about the whole sequence, go to the Questions Menu (Figure 1c), or to return to the last menu (Figure 1f).

If the subject chose to answer questions about a segment or a sequence, all embedded questions of that segment or sequence where presented successively. All questions were either multiple choice questions or short answer questions. Next feedback was given. In case of a false answer the subject had a second chance to answer the question. This option was built in for the fact that subjects tended to make a lot of typing errors which they could correct at this point. If the answer was still not correct the related video fragment was repeated followed by a third opportunity to answer the question. As soon as feedback was completed, the subject was presented the next menu. After a stop within a sequence the subject could choose to go to the beginning of the next segment (which starts with the information element that follows the one in which he/she stopped) or to return to the Video-Sequence Menu. After a stop at the end of a sequence, the subject could choose to go to the beginning of the next sequence or to return to the Video-Sequence Menu.
If the subject had completed the viewing of a whole video sequence, the related menu item of the Video-Sequence Menu was checked. The same counted for the questions. If all embedded questions of a sequence were answered it was checked in the Questions Menu. The subject had to answer all embedded questions before he/she was allowed to leave the program.



Main Menu

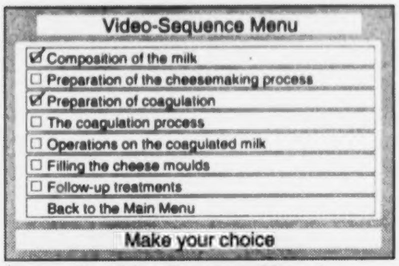
Presentation of video sequences

Questions Menu

Stop

Make your choice

Figure 1a. Main Menu.

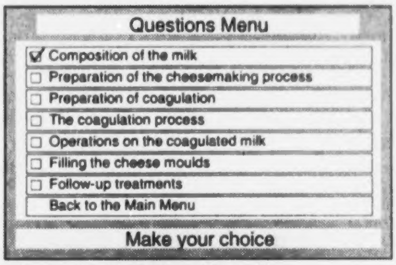


Video-Sequence Menu

☑ Composition of the milk
☐ Preparation of the cheesemaking process
☑ Preparation of coagulation
☐ The coagulation process
☐ Operations on the coagulated milk
☐ Filling the cheese moulds
☐ Follow-up treatments
Back to the Main Menu

Make your choice

Figure 1b. Video-Sequence Menu.*

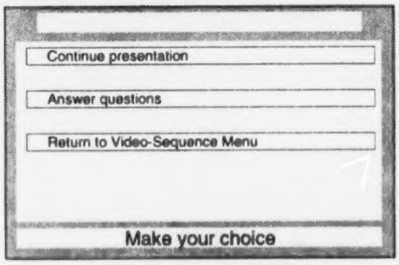


Questions Menu

☑ Composition of the milk
☐ Preparation of the cheesemaking process
☐ Preparation of coagulation
☐ The coagulation process
☐ Operations on the coagulated milk
☐ Filling the cheese moulds
☐ Follow-up treatments
Back to the Main Menu

Make your choice

Figure 1c. Questions Menu.**



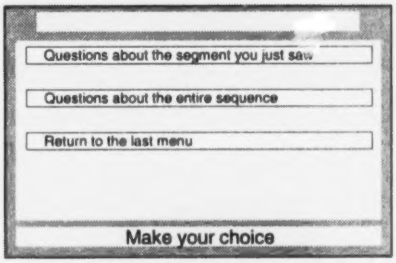
Continue presentation

Answer questions

Return to Video-Sequence Menu

Make your choice

Figure 1d. Menu after a segment not being the last segment of a sequence..



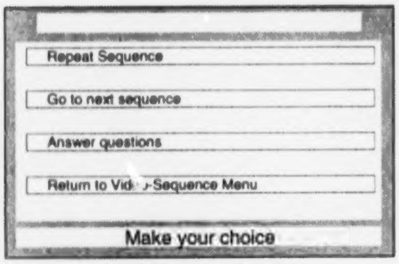
Questions about the segment you just saw

Questions about the entire sequence

Return to the last menu

Make your choice

Figure 1e. Questions after a segment not being the last segment of a sequence..



Repeat Sequence

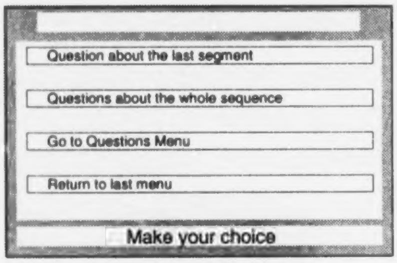
Go to next sequence

Answer questions

Return to Video-Sequence Menu

Make your choice

Figure 1f. Menu at the end of a sequence.



Question about the last segment

Questions about the whole sequence

Go to Questions Menu

Return to last menu

Make your choice

Figure 1g. Questions after the last segment of a sequence.

* The menu in this figure is presented in the situation that the first and third sequence have been watched entirely .

** The questions of the first sequence have been answered.

Figure 1: Menu structure of the experimental program (main condition)

The distribution of information elements, objectives and questions over the different menu items is listed in table 1.

Table 1. Distribution of information elements, objectives and questions.

Sequences	Number of information elements	objectives	embedded questions
Composition of the milk	25	3	12
Preparation of the cheese making process	27	8	9
Preparation of coagulation	34	7	12
The coagulation process	25	6	20
Operations on the coagulated milk	35	15	17
Filling the cheese moulds	29	4	8
Follow-up treatments	41	7	19
Total	216	50	97

The data presented in Table 1 only account for the main program (Information Elements 34 to 249), which was the measuring section of the program.
The 33 information elements of the introduction -- with an overview of the cheese making process -- counted 25 embedded question. In order to practice the menu structure, the introduction was divided into two sequences.

Subjects

The target group of Verhagen's experiments consisted of university freshmen. This target group is atypical with respect to the educational objectives of the current experiment. Cheese making is mainly taught on different levels of agricultural vocational education. The target group of the current experiments is therefore selected on the middle level of Dutch agricultural vocational education. Two schools participated to yield sufficient subjects. In both schools, first-year students were involved in one of two programs: a three-year program that is more practice oriented (35 subjects) and a four-year program that aims at a higher level of theoretical background than the three-year program does (38 subjects). Analysis of the data revealed that with respect to the current experiment both groups showed no significant differences (Breman, 1995, in Dutch). In this contribution, the research results will therefore be described on the basis of the pooled data of all participants in a certain condition.

Experimental conditions

EXPLORE:
In this condition the subjects were familiarised with the instructional objectives and then offered the menu-driven environment as described before, to explore the videodisk by choosing video sequences from the Video-Sequence Menu (Figure 1b) or by entering the knowledge domain by choosing a group of questions to answer from the Questions Menu (Figure 1c). The subjects worked through the program, dividing each video sequence if so desired into a series of longer or smaller segments according to the procedure that was explained in the description of the program. The subject could decide to answer, after each segment, the segment-related questions (and then get feedback and remediation) or could choose to do something else (such as interrupting working through a sequence and return to a menu to make a new selection). In this way, a situation of complete learner control existed, with the already mentioned exception that all questions had to be answered before leaving the program.

GUIDE:
In this condition the subjects were familiarised with the instructional objectives as in the Explore Condition and then were offered the different sequences of the program in a linear order. The presented sequences could not be interrupted. The Guide Condition was a fixed-length condition in which

presentation of videodisk segments, answering questions, and remediation in case of incorrect answers were incorporated in a tutorial format under program control.

LINEAR:
This condition resembles Verhagen's Linear Condition in that the subjects were forced to watch the whole program without stopping. In this case, however, the subjects were informed about the instructional objectives beforehand just as in the Explore and Guide conditions. Unlike the other conditions, there were no embedded question incorporated in this condition.

VARIABLE:
Given the different target population compared to university freshmen, the main condition of the earlier experiment by Verhagen (1992a, 1992b) was repeated as a fourth condition. In this condition, the subject could operate the program in a way similar to the procedure of the Explore Condition. However, no menu structure was used and no sequences were predetermined. Instead of the 97 objective-oriented questions, the 213 questions of Verhagen's experiment were used. The questions in Verhagen's main program (which was the measuring section) are about the presented factual information that is contained in the information elements. In this condition, the video program was presented in a linear way. The subjects could interrupt the program by clicking a mouse button. The subject then answered all questions about the segment just viewed. The questions were all open questions that required short sentences, single words, or numbers to be typed in as answer. Next feedback was given. Subjects had no chance to correct false answers before remediation. In case of a false answer the related video fragment was repeated followed by a second chance to answer the question and feedback on that answer. After all questions of the segment were reviewed, the subject was allowed to continue the program beginning with the information element that followed the last element of the completed segment. The subject had control over the length of each video segment, but no control over the sequence of the video program.

Research method

The experimental method is a pre-test/post-test/retention-test design.
The data were collected during the September-October period of 1994. Five computer-videodisk-player combinations were available (Olivetti M240 and M290 MS-DOS-computers with MCS Video-overlay boards and Philips videodisk players of the 400 series). The experimental sessions thus had a maximum of five subjects per session. For each subject, written instructions about working with the program were available for reference, together with a pen and four sheets of paper for making notes, and a study guide that contained the instructional objectives as the main components for the preparation of the subjects to work with the program. The experiment was carried out according to the following procedure:

- The experiment was introduced by a brief oral presentation.
- Next, a paper-and-pencil pre-test of 25 multiple-choice questions was administered.
- This was followed by an introduction of the subject of the experiment by presenting a video segment of 4.5 minutes that gives an overview of the cheese making process. This introductory sequence is composed of the first 33 information elements of the videodisk program.
- In the learner-control conditions the experimental procedure was then practised by working through the introductory sequence a second time in the way that was required for the measuring section (the 219 information elements of the main program). In the other conditions this step was skipped.
- In the next step, the subjects were invited to study the instructional objectives that were presented in a study quide.
- A questionnaire was administered with respect to the expectancies related to working with the experimental program. The subjects answered three five-point-scale questions to get an indication of their attitude towards the program (I expect to like/dislike working with the program), the Perceived Demand Characteristics (PDC) of the program (What I have to learn seems difficult/easy to me), and the Perceived Self Efficacy (PSE) with respect to the task (To be able to complete the post-test satisfactory, I will have to invest much/little effort during working with the program).
- After all these preparatory activities, the experimental task was carried out. The researcher remained available for answering questions and solving mainly minor technical problems that did occasionally occur.

- After completion of the task, the subjects were allowed to go one time more through their notes and the list of instructional objectives.
- The next step was administering a questionnaire of seven or eight five-point-scale questions (dependent on the experimental condition). The first three questions were similar to the questions of the first questionnaire. The question "I liked/disliked working with the program" was used to find out whether the initial attitude did change. The question "What I had to learn was difficult/easy" was again intended to get an indication of the PDC of the program. The question "I had to invest much/little effort during working with the program" was used to get an indication of the Amount of Invested Mental Effort (AIME) to complete the experimental task. The other questions mainly concerned the audio-visual presentation of the program. The answers revealed no problems with the quality of the program as a professional audio-visual product. These questions will therefore not be discussed further. More information can be found in Breman (1995, in Dutch). One question asked to estimate the expected success in making the post-test (Now that I completed the task with the program, I expect that I will perform well/poorly on the post-test).
- After the questionnaire, a paper-and-pencil post-test of 25 multiple-choice questions was administered.
- After the post-test, a third and last questionnaire was administered, this time consisting of four five-point-scale questions. One question concerned the test performance (Now that I completed the post-test, I think that I did well/poorly). This question relates to the question about the expected success in making the post-test. The results show that the subjects made a poor estimate of their ability to perform well on the post-test, while their judgement of their performance on the post-test after completing it, was much better. For the pupose of the present study, this issue needs no further attention. The other questions asked for preferences with respect to learning from books, video, or from the teacher. The results of these questions are, again, not included in the present contribution. Detailed results are available from the authors.
  The post-test concluded the first session.
- After three weeks a paper-and-pencil retention test was administered that again had 25 multiple-choice questions.

Pre-test, post-test and retention test were composed from a pool of 75 questions that consisted of 25 groups of three questions. The three questions in a group were variants of one and the same question. To prevent test bias, the allocation of each of the three questions in a group to either the pre-test, the post-test, or the retention test was done randomly for each individual subject. Each subject thus received own versions of the three tests.

Results

Self-chosen segment length

Table 2 and Figure 2 show the differences between the Variable Condition and the Explore Condition with respect to self-chosen segment length.

The mean of mean self-chosen segment length in the Explore Condition appears to be more than twice the length of the mean self-chosen segment length in the Variable Condition. This difference is significant (N=33, F=23.68, p<.0001, tested with a one-way analysis of variance).
A possible explanation could be that the number of embedded questions was very different in these two conditions. To be able to reflect on that difference, segment length is also expressed in terms of the number of questions that the subjects had to answer for each segment. Mean and standard deviation (SD) of this measure are presented in the two most-right columns of Table 2. In this case, no significant differences are found (N=33, F=0.22, p=.64, tested with one-way analysis of variance). The interpretation of this fact is, however, difficult because of the unequal distribution of embedded questions and learning objectives over the 7 video sequences of the Explore Condition (Table 1).

Table 2: Mean of mean self-chosen segment length by condition.

		Mean segment length expressed in terms of			
		number of information elements		number of questions	
Condition	N	M	SD	M	SD
Explore	20	21.55	7.75	9.50	3.37
Variable	13	8.85	6.59	8.69	6.46

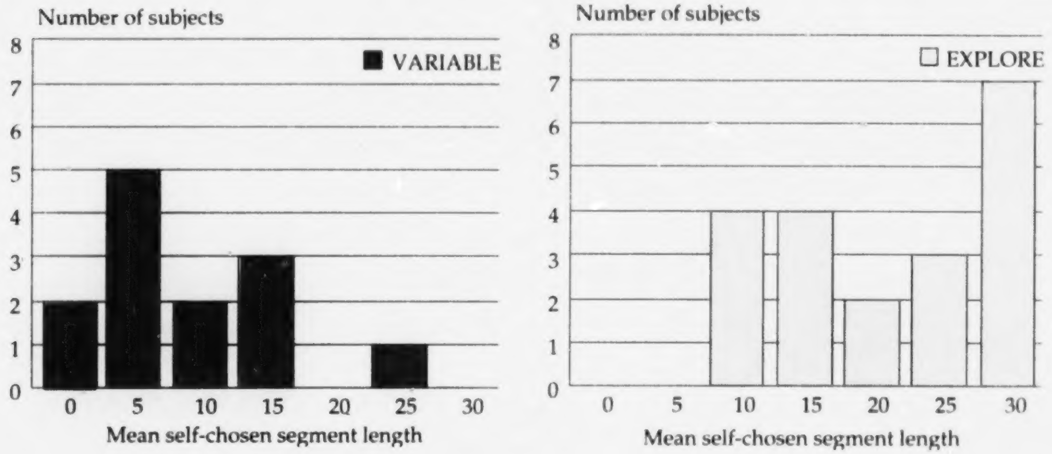


Figure 2: Distribution of self-chosen segment length

Test performance and self-chosen segment length

The relationship between mean self-chosen segment length and test performance is analysed by correlating mean self-chosen segment length with the differential scores of the different tests. Table 3 shows the correlations of the Variable Condition as well as of the Explore Condition with the differences of post-test and pre-test scores and of retention test and pre-test scores. For this analysis the non-parametric correlation coefficient 'Kendall's tau' has been used. Table 3 shows that there is no reason to infer that mean self-chosen segment length affected test performance.

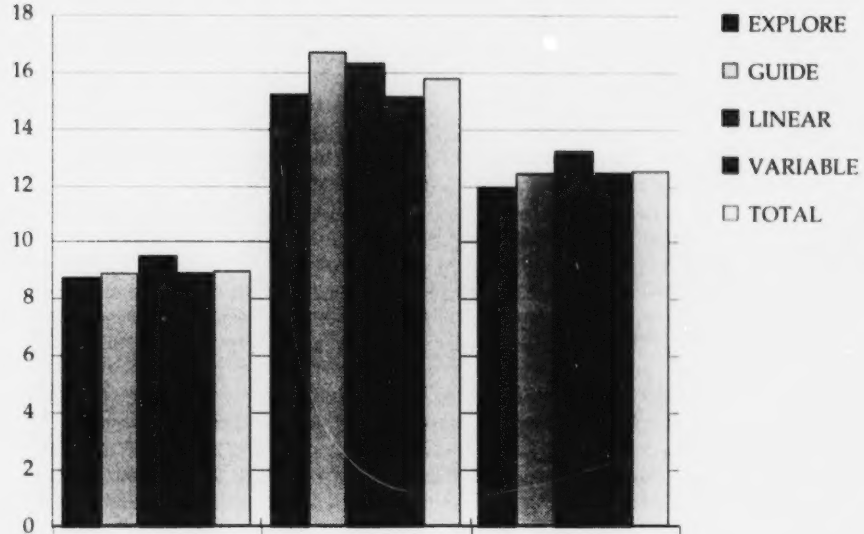
Table 3: Correlation between mean self-chosen segment length and test performance

		Post-test minus pre-test scores		Retention test minus pre-test scores	
	N	t	P	t	P
Condition:					
Explore	20	0.07	0.74	-0.04	0.80
Variable	13	-0.03	0.89	-0.20	0.34

Test performance and condition

Figure 3 shows mean test scores on pre-test, post-test and retention test for each of the experimental conditions. Test scores are absolute scores. The maximum test score was 25 in all cases.

No significant differences are observed with respect to pre-test scores (N=73, F=.22, p=.88). For the post-test and retention-test scores, the data of Figure 3 are not suitable to analyse differences between conditions. The reason is that pre-test scores varied considerably, ranging from 3 to 16.



		Pre-test		Post-test		Retention test	
Condition	N	M	SD	M	SD	M	SD
EXPLORE	20	8.75	3.14	15.25	4.04	12.00	3.10
GUIDE	18	8.94	2.48	16.72	4.03	12.50	2.81
LINEAR	18	9.50	3.03	16.33	2.00	13.24	2.02
VARIABLE	16	8.94	3.07	15.15	3.63	12.46	2.88
TOTAL	72	9.03	2.90	15.90	3.52	12.53	2.72

Figure 3: Mean test scores per condition

The assumption that the subjects had no pre-knowledge about cheese making appears thus not to be completely true. To estimate knowledge gain, differential scores are used. Figure 4 shows the mean scores of post-test minus pre-test and of retention test minus pre-test for each of the conditions.

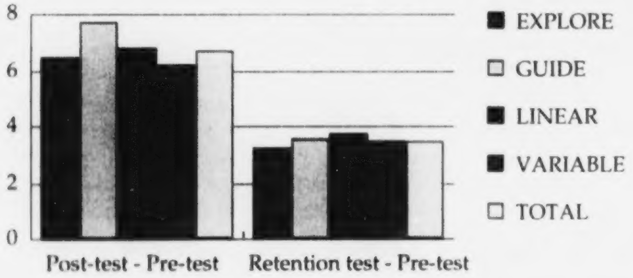


Figure 4: Mean differential scores per condition

Figure 4 shows that subjects who worked in the Guide Condition gained most, on average, between pre-test and post-test. Subjects in the Linear Condition did best on the retention test. Two-way analysis of variance, however, revealed no significant differences.

AIME

The score on the question "I had to invest much/little effort during working with the program", which was part of the questionnaire that was administered directly after the completion of working with the experimental program, was used as an estimate of the Amount of Invested Mental Effort (AIME). The score on the question "To be able to complete the post-test satisfactory, I will have to invest much/little effort during working with the program", which was part of the questionnaire that was administered before working with the experimental program, was used as an estimate of Perceived Self Efficacy (PSE). The Perceived Demand Characteristics (PDC) of the program were rated twice: by the score on the question "What I have to learn seems difficult/easy to me" before working with the program and by the score on the question "What I had to learn was difficult/easy" after working with the program. Table 4 shows the correlations (Pearson's R) between AIME and the other measures. The significant results for the relationship between AIME and PSE suggest that the subjects were honest in their answers and indeed seriously invested effort when they expected that the difficulty of the task needed it. This is reinforced by the fact that more significant positive correlations emerged between AIME and PDC after working with the program than before working with the program. The experience of working with the program seems to have helped the learners to adjust their AIME to the task.

Table 4: Correlations of AIME with PDC and PSE.

AIME versus:	PDC before		PSE		PDC after	
	R	P	R	P	R	P
ALL SUBJECTS	0.39	<.001	0.68	<.001	0.48	<.001
EXPLORE	0.55	0.01	0.77	<.001	0.44	0.05
GUIDE	0.18	0.47	0.61	<0.01	0.68	<0.01
LINEAR	0.34	0.16	0.79	<.001	0.59	0.01
VARIABLE	0.21	0.45	0.52	0.04	0.00	1.00

Table 5 shows that the subjects adjusted their PDC due to working with the program. In three conditions, a significant positive correlation seems to imply that the initial PDC was in most cases a fair estimate. In the Variable Condition this was clearly not the case. The reason could be that practicing the experimental procedure with the introduction was eventually not perceived as representative for the task in the measuring section. The data showed that in this condition, PDC was rated to be slightly more difficult before working with the program than after working with the program.

Table 5: Correlations of PDC before working with the program with PDC after working with the program.

PDC after versus:	PDC before	
	R	P
ALL SUBJECTS	0.46	<.001
EXPLORE	0.73	<.001
GUIDE	0.56	0.02
LINEAR	0.46	0.06
VARIABLE	0.04	0.89

The effect of AIME on test performance was analysed using a Kruskal-Wallis one-way analysis of variance (Table 6). No significant relationships were discovered. In the Explore Condition a light tendency towards some influence of AIME is visible.

Table 6: Differences in performance by AIME scores for the different conditions.

	AIME scores versus: post-test minus pre-test scores		retention test minus pre-test scores	
	Chi^2	P	Chi^2	P
ALL SUBJECTS	3.13	0.37	1.37	0.71
EXPLORE	5.35	0.15	5.90	0.12
GUIDE	0.36	0.95	2.13	0.55
LINEAR	2.53	0.47	3.13	0.37
VARIABLE	0.36	0.83	1.05	0.59

The difference of AIME-Scores between condition showed some significance (Table 7). Analysis of the data, using the Mann-Whitney U-Wilcoxon Rank Sum W test corrected for ties, showed that for working with the Explore Condition significant less mental effort was invested than in the Linear Condition (P=.05) or in the Variable Condition (P=.01). Other relationships were not significant, although the Guide Condition shows a tendency to have required less effort than the Variable Condition (P=.09).

Table 7: Difference in AIME-Scores between conditions.

	Conditions	
	Chi^2	P
AIME	8.07	0.05

Discussion

In a first instance, the mean of mean self-chosen segment length in the Variable Condition (mean of mean length: 8.85) seems to differ from the results from Verhagen's earlier experiment. However, the mean of mean segment length in his study (12.70 Information Elements) was in itself the mean of the results from three different groups. They were university students from engineering departments (mean of mean length: 17.66 Information Elements), students from a faculty of public administration (mean of mean length: 14.07 Information Elements), and students form a faculty of educational science and technology (mean of mean length: 7.42 Information Elements). The results of the present study compare to the results of the last group and can thus be regarded to fall within the normal range of the experimental method of the earlier study.

The difference between the Variable Condition and the Explore Condition seems therefore to be attributable to task differences. Although the subjects in the Variable Condition were oriented on the experimental task by the pre-test and the list of learning objectives just as the subjects in the other conditions were, it seems likely that the large number of very specific questions in this condition did shape their behaviour. They adopted, in other words, a strategy for working through the program that compares to the university students in the earlier experiment by Verhagen (1992a). The result that AIME and PDC showed hardly any or no relationship in the Variable Condition (Table 4 and Table 5) may be interpreted to support this view. In all other conditions, the task requirements were consistent with the orienting activities. In these conditions, embedded questions were designed to relate to the explicitly stated learning objectives. Working with the program thus helped to clarify PDC. The own set of questions of the Variable Condition and the relatively rigid experimental procedure in this condition may have caused interference in that respect.

The answer to the first research questions seems to be positive. The task structure of the Variable Condition, which was in essence an exercise in memory performance, lead to segment lengths that were, on average, four-tenths of the length of the self-chosen segments in the Explore Condition, which was an instructional environment under learner control.

No evidence was found that test performance was related to self-chosen segment length (Table 3). Differences in test performance between conditions were small. Subjects who worked in the Guide Condition did best on the post-test. Subjects who worked in the Linear Condition did best on the retention test. These results are similar to the results of Verhagen (1992b). Mean length of the fixed segments in the Guide Condition was 30.86 Information Elements (in time: about 4,5 minutes), while the mean of mean self-chosen segment length in the Explore Condition was 21.55 Information Elements (in time: about 3 minutes). Also Verhagen found that forced watching of relative long segments supports learning. Whether this implies more invested mental effort, however, is not clear. The self-reported AIME by the subjects does not show any relationship with test performance (Table 6). With respect to the Linear Condition: In Verhagen's case this condition also outperformed all conditions on the retention test. He suggested that the fact that subjects who watch the linear version are provided with an overview of the whole program, may support later recall. The data from Breman (1995) show that in the Linear Condition the subjects completed the experimental task in about half of the time that was needed for the Explore Condition or the Guide Condition. The Variable Condition took even more time. Breman further found that after working with the program, the subjects in the Linear Condition liked the program better than the subjects in any of the other conditions. These facts, combined with the positive results of the Linear Condition regarding retention-test performance, suggest that when video is considered for instruction with the acquisition of factual knowledge as its main goal, linear video should be preferred instead of interactive video. This conclusion is further supported by the conclusion of Schaffer and Hannafin (1986) who found that linear video had the highest Acquisition Rate.

The second research questions asks what differences can be observed between self-chosen and program-controlled segment length regarding the investment of mental effort of subjects. The answer is found in Table 7. According to the self-reports by the subjects, for working with the Explore Condition significant less mental effort was invested than in the Linear Condition or in the Variable Condition. The Guide Condition shows a tendency to have required less effort than the Variable Condition. The Explore Condition and the Guide Condition are new conditions that have been developed to provide a well-designed learner-controlled or program controlled system, respectively. Both conditions appear to offer the most relaxed learning situation and -- if comfort may be taken as a criterion -- the best usability. This usabilty aspect does not support the preference for linear video that was concluded before.

That the Guide Condition requires more AIME than the Explore Condition is probably due to the fact that the mean length of the fixed segments in the Guide Condition was about 1,5 times the mean of mean self-chosen segment length in the Explore Condition. It would be interesting to know how data would change if the mean length of the fixed segments in the Guide Condition would be adjusted to be similar to the mean length of the Explore Condition. Would AIME be reduced? Would then the better performance on the post-test also be reduced? A clear recommendation which of these conditions should be preferred is, in any case, not possible on the basis of the present data.

The third research question concerns the relationship between AIME and test performance. No such relationship could be demonstrated (Table 6).

Conclusion

Different approaches for segmenting video and organising interaction appear to yield different results with respect to test performance, instruction time, AIME, and liking of a learning task that concerns the acquisition of factual knowledge. Linear video shows some advantages for learning of factual knowledge. A clear preference for linear video over interactive video is, however, not indicated in all circumstances. On the basis of the results of the present experiment, the amount of mental effort that is required for relatively long linear programs seems to be more than in interactive programs in which the video is segmented in a proper way. In situations where next to learning factual knowledge also more complex learning outcomes are desired, the advantages of linear video may remain valid for the factual components of the instruction. A well-designed interactive video application may offer a comfortable work environment that allows for a relaxed use of mental effort. The results of the experiment seem to suggest that video segments with a length of about 3 minutes, containing enough factual information for answering 8 or 9 questions, may appear to be optimal building blocks. Subsequent experiments should, however, reveal to what extent this suggestion is valid.

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Title:

Distance Learning Revisited: Life-Long Learning and the National Information Infrastructure

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Introduction

Enterprises of all sorts tend to develop modes of operation that, over time, come to be accepted as the "conventional way." Education has always relied heavily on one format: the classroom model. Distance education--which, in its early years, was likely seen as an unconventional way to facilitate learning--developed its own conventional model: the "correspondence course." And despite continuous progress in developing alternative means of communication, these conventional formats have been slow to give way to innovative approaches. Now, in the face of what Lewis Perelman (1992) calls "an implacable technological revolution," that appears to be changing. What this revolution entails and how it may affect education, and distance learning in particular, are critical questions for educators everywhere.

This paper therefore "revisits" distance learning by addressing its past achievements, its present state, and its future in the face of the rapidly converging computer and communications technologies and the goals and potential that underlie the creation of the proposed National Information Infrastructure (NII). The analysis was undertaken recognizing that new demands are being placed on our educational institutions to provide a highly knowledgeable and skilled workforce for the Twenty-First Century; that the stakes involved are no less than our economic competitiveness--which is now so knowledge dependent; and, that consideration of the present and future of distance learning requires a "paradigm shift" in the role of teachers and educational institutions as the United States enters into a global economy.

This inquiry therefore seeks to create a contemporary vision of distance learning based on 1) its history, 2) the recognition of the importance of life-long learning and the development of new strategies for its realization; 3) the potential of emerging telecommunications technologies; 4) the respective roles of private industry and government in the creation of the National Information Infrastructure; and 5) the potential contribution of The High Performance Computing and Communications (HPCC) initiative. We began to construct this vision by examining efforts to define distance education and to establish its theoretical base, distance education's major milestones, technology's expanding role and potential, and new opportunities that derive from the National Information Infrastructure Initiative.

Distance Education Versus Distance Learning

A definition that accurately describes an activity's nature and function is essential for judging its history and creating a vision of its future. Schlosser and Anderson (1994) state that the term "distance education" has been used to describe a great variety of programs employing a wide variety of media. And they cite several scholars who have expanded on distance education's key element--bridging the physical separation that exists between teacher and student via some medium: Rudolf Delling emphasized that distance education is "a planned and systematic activity [that involves] didactic preparation and presentation of teaching materials as well as the supervision and support of student learning...;" Greville Rumble declared that distance education involves a "contract" between the student and the teacher, or teaching institution, that defines respective roles; and Desmond Keegan noted that despite the separation of teacher and student, the influence of an educational institution, the provision of two-way communication and the possibility of occasional meetings all distinguish distance education from private study . Moreover, in distance education, much communication occurs noncontiguously.

These points are well made. But, to simplify, here we use the term "distance education" to indicate the organizational apparatus and process for providing educational experiences to people at a distance, and the term "distance learning" to refer to the process and result of attending to, and responding to, such experiences. As future developments in both communication and knowledge access technologies provide learners with increased capability to learn independently, we expect the distinction between distance education and distance learning to become more meaningful.

Distance Education Milestones

Distance education's history is more than a catalog of program growth and technology evolution, although that is part of it. Schlosser and Anderson (1994) trace distance education's roots in the United States to 1873 when correspondence study "crossed the Atlantic" from Europe and The Society to Encourage

Studies at Home was founded in Boston. Other programs followed as correspondence study continued to expand into the twentieth century.

By the 1920s, electronic technology had become a major factor in distance education with at least 176 radio stations being built at educational institutions. Most, however, did not survive the decade (Schlosser and Anderson, 1994). Some did remain, however, and by the 1950s, a second broadcast medium, television, began to play a growing role in distance education. Western Reserve University and New York University, with its well-known Sunrise Semester courses on CBS, were early users of the medium. Later, as satellite television became cost effective, television's role expanded. The first state educational system, Learn/Alaska, began operations in 1980.

Schlosser and Anderson (1994) mark the 1962 decision by the University of South Africa to become a distance education institution as the beginning of a "fundamental change in the way distance education was practiced in much of the world." The founding of the Open University of the United Kingdom in 1971 was another landmark. As a degree-granting institution dedicated to distance teaching, it extended the university opportunity to many and brought added prestige to distance education as an enterprise. The Open University offered degree programs in many fields and made wide use of communication media. Similar institutions soon followed in Canada, Japan and West Germany, although not all embraced the Open University's liberal enrollment policy.

A good measure of distance education's recent growth is the number and variety of programs presently available. Peterson's Guides 1993 publication The Electronic University is one excellent source of information on "telecourses" and degree programs offered "electronically" to US and Canadian inhabitants. It describes nearly one hundred institutional, network or consortia-based programs. Well known consortia currently offering distance learning programs include the International University Consortium (IUC), Mind Extension University (ME/U), the National Technological University (NTU), and the Electronic University Network (EUN).

Technology's Growing Influence On Education

Technology, as it advances, is playing a larger role in both school-based and distance education. In schools we have seen technology use evolve from "audiovisual aids" used to support classroom lectures to various forms of media-intensive learning centers and, more recently, to modern interactive technology systems. In distance education, educational radio--which expanded greatly after 1925 (Saettler, 1968)--was followed by broadcast television and teleconferencing as major delivery innovations.

An interesting study by Wilkinson and Sherman (1991) provides a useful portrait of distance programs then active. They contacted 276 higher education distance education programs and received 142 "usable" survey responses. With regard to the primary method of delivery for various courses across all institutions, video-based technology was the most frequently used method with about three-fourths of the programs using video in more than half of their courses (p. 56). Print-based instructional delivery was second in frequency of use with both audio- and computer-based technology enjoying lower usage. Print, however, was the primary method of student/faculty interaction in over 75 per cent of courses offered. Clearly, most institutions employ a variety of media to conduct their courses.

The marriage of computers and communication media has led to new forms of in-school learning environments--usually some form of learning station or desktop application--that both supplement and replace standard classroom experiences. In distance learning, use of teleconferencing tools that enable two-way communications is increasing. And networks now enable educators and learners to communicate through e-mail and bulletin boards and to collaborate on problem solving tasks.

Thus, as the power and versatility of computer-mediated communication is amplified by new tools with enormous capacities to store, transmit and control information, technology can offer educators a broad selection of interactive learning systems. These include desktop interactive multimedia, electronic classrooms and other local-area network applications, wide-area network and teleconferencing systems, virtual reality environments and "microworlds." And the proposed National Information Infrastructure (NII) and "intelligent assistants" (Roesler and Hawkins, 1994) are reportedly just over the horizon. So while the term "information highway" may be a poor technical metaphor, there is an analogy related to its construction with which educators, and the "highway's" builders, can relate. The interstate system was envisioned in the 1950s as a new kind of road (a "superhighway") that would provide greater traffic volume and increased speeds. The NII, when completed, will expand information traffic in much the same way. For distance educators, and the computer, telephone and cable industries, it is the 1950s again; a time to make long-range plans--in terms of both distance and time. Indeed, as distance learning programs are helping to recast the traditional campus, newer technologies are promising to recast distance learning itself. It truly may be, as The Electronic University proclaims, "the hottest education trend of the 90s."

Distance Learning in Transition

Distance education's ongoing efforts to employ new technologies to reach learners, to incorporate new teaching methods and to create new administrative forms has placed distance learning in a definite state of transition.

Distance Learning: The Current Picture

From a near-total reliance on print-based courses, technology use in distance learning expanded to include broadcast radio and television and, later, audio, video and computer teleconferencing. Now computer-based, multimedia teleconferencing systems are the emerging trend (Romiszowski, 1993). Such sophisticated new technologies are presently shifting the emphasis "from single-technology delivery systems to integrated approaches seeking to...combine voice, video, and data technology, often in tandem with print" (Willis, 1993, p. 10).

With respect to methodology, many distance educators seem to describe and gauge the instructional models they employ in relation to conventional classroom practice. Correspondence study suffers in this perspective; it offers no live Communication. Open broadcast radio and television offer the lecture aspect of the classroom, but not the interaction opportunities. The early teleconferencing systems offered limited learner participation, mainly through telephone communication. The new computer-mediated telecommunications systems are being touted highly because they promise, via "real-time" multimedia interactive communication, the "virtual" equivalent of the regular classroom experience.

It would be a mistake, however, to limit the concept and practice of distance learning to the simple notion of delivering conventional classroom instruction at a distance. This would "short circuit" the potential of telecommunications technology to transform education as we know it into a process for enabling children and adults of all ages to empower themselves and to become viable members of the emerging global society and economy. Distance learning must provide opportunities to acquire knowledge and skills both during one's formal education years and on a "just in time" basis throughout life to meet the constantly changing requirements for adult productivity in our society.

The question of what institutional structures are needed to accommodate distance learning activities has become critical. Although university level distance education has grown steadily and upgraded its technology component throughout the twentieth century, from an institutional perspective it remained for a long time what Michael Moore (1993) calls a "first generation" model. That is, distance students received, either by correspondence or by telecommunications, "classroom-like teaching...provided by conventional teachers...." The 1969 opening of Britain's Open University as an institution specifically dedicated to creating and delivering distance education programs--and of similar institutions in other countries--was a major milestone (Willis, 1993). These "second-generation distance education institutions," Moore (1993) observed, "had no classrooms [since] learning occurred in students' own environments." Faculty were chosen specifically for distance teaching and the institutions were given the authority to grant their own degrees. But although the Open University model breaks the tradition that requires teacher and students to meet in a classroom for all educational transactions, it shares with conventional schools one very important feature: courses are developed and taught and achievement is certified by the faculty associated with a particular place. Students therefore are as limited in their selections of courses and teachers as they are at a conventional "brick-and-mortar" campus.

Recent technology developments promise to remove such limitations. We are, Moore (1993) suggests, "rapidly approaching technical readiness for the Virtual University, the third generation of higher distance education." In such universities, courses developed anywhere are made available to students everywhere, as is wide access to libraries and other resources for information and guidance. Moore's prescience was demonstrated in late 1994 with the advent of the Virtual Online University (VOU). It offers, on the Internet, a virtual education environment that combines the academic environment of a physical world university plus the creative dimension of a Multi-User Domain or MUD.

Issues in Distance Learning

There is, however, in the creation of a viable regional, national or global distance learning organization, more to be decided than what technology will be employed and how it will be used. As Rossman (1993) asserts: "The agenda for global education begins with questions about who is to coordinate and regulate electronic courses offered on network or satellite; who is to set standards, especially when nations and universities disagree;...and who is to arbitrate and decide on such matters as degrees and exchange of course credits" (p. 13). And as various state systems and institutions expand distance learning offerings, we can expect numerous policy and administrative issues to come to the fore.

Thus reaching a state of "technical readiness" for what Rossman (1993) calls The Emerging Worldwide Electronic University, may be easier than reaching an equivalent state of readiness in the curricular and administrative areas. Moore (1993) cites the major administrative problem: "In spite of a number of efforts to establish certification of learning by non-traditional methods, there is still no agency in North America that has the power, recognition, or authority to provide a certification of independent, individually constructed learning programs that has credibility in the academic and business environment comparable to the degree awarded by a brick-and-mortar university" (p. 6). And the problems that typically accompany the development and introduction of innovative educational programs are likely to be amplified in the distance learning arena. Jacobson (1994) recently identified several important issues associated with extending the reach of "virtual" classrooms, including: 1) the effect of distance learning on faculty workload/compensation; 2) faculty involvement in course design; 3) faculty job security; 4) certification in-state and across states; and 5) concern that distance learning becomes more than simply transmitting lectures from one place to another.

So as advancing technology affects perceptions of what instructional outcomes can be accomplished at a distance, a number of vital questions follow: Do current definitions of and theories about distance education provide an adequate basis for exploiting the potential of future distributed learning structures? Or do they matter at all? Are the design principles of conventional education adequate for developing distance learning programs? Are institutions up to the task? What are the respective roles of teachers and learners in both short-term and life-long distributed learning applications? How should distance learning designs respond to current trends in American professional and industrial settings that are transforming work and models of learning?

Perhaps more than ever before, distance learning remains an enterprise in transition, a transition driven by advances in technology, recognition of the need to improve the quality of education, a growing demand on the part of various student populations for increased learning opportunities, and the need to make maximum use of available resources. With so many forces affecting distance learning's future, it seems fair to say that we know better where the technology is going than we know where we are going with the technology. Why? Mainly because the "enabling technologies" required to create a national or global information "infrastructure" are known, their past development has been carefully noted, and their projected development in the years immediately ahead is fairly predictable. This applies to computer chips, which provide processing power, to storage devices, which promise massive increases in capacity, to optoelectronics, which is increasing communication speed , to advanced switching devices needed to blend voice, video and data, to digital compression techniques, and to software technology, which is moving steadily toward the goal of providing so-called "intelligent" agents to help users manage the information available to them.

But how competition in the commercial world of communications companies will play out, what role the government will assume, what initiatives various educational institutions will launch, and what learning opportunities students at all levels will eventually find on their on-line menus are questions that remain to be answered. Both these issues and the related technologies are explored in what follows.

The National Information Infrastructure and New Opportunities For Distance Learning

Much has happened since Stewart Brand (1989) predicted the inexorable merging of the publishing, broadcasting and computer industries. Private competition among cable, telcos and the computer industry, aided by government legislation and programs, have made Brand's words seem prophetic. A world in which analog information originates from and is controlled by a central source and broadcast at fixed times to many simultaneously is being replaced by digital information originating from a myriad of independent sources and available asynchronously. The capture, manipulation, transmission, and consumption of information in digital form has become a critical function of our economy (Shepard, 1994). Exponential advances in microchip technology and networked computers (Gilder, 1994a) have resulted in wide-spread application of peer to peer computing . Increased "bandwidth" and advances in compression/decompression technology are enablinging the seamless integration of multimedia (voice, data, graphics and video) over local and wide area networks. The multimedia content carried on these networks touches upon all aspects of life: education, entertainment, community, commerce, and health.

An Interconnected World

Today's networks number more than 100,000 and represent a panoply of private, public and government local (LAN), metropolitan (MAN) and wide area networks (WAN). Among them, the Internet, a world-wide "network of networks" (Krol, 1994) that share TCP/IP and similar protocols is the most widely known and used. The Internet has become popularized by the media and is sometimes referred to as "cyberspace," a concept first described in popular Canadian science writer William Gibson's 1984 novel Neuromancer. The Internet has grown exponentially at a rate of ten percent a month and, by 1994, exceeded two million interconnected computers worldwide (Comer, 1995). The approximately thirty million users of the Internet vary from individuals with local area network access to individuals who subscribe to service providers such as America Online, Compuserv or Prodigy for access from computer modems. This trend toward computer-mediated communication (CMC) over long distances is further accelerated by the commercial development and marketing of personal digital assistants (PDAs) and the newly emerging array of personal communications services (PCS) that add digital cellular telephones and wireless digital networks to the mix.

Private and government efforts to design, test and build the electronic infrastructure to succeed the Internet--the "National Information Infrastructure" (NII), or so-called "Information Superhighway"--have taken on a new urgency over the last several years. This urgency is driven both by competition among telcos, cable, and computer companies for a share of the lucrative telecommunications market and by the desire to apply technology in the service of society. While rooted in different motivations and goals, private and government initiatives have complemented each other and have hastened the development of an information-based society and economy. Indeed, Peter Drucker (1994) has noted the emergence of "knowledge workers" as a dominant group in our society and predicts that by the end of the twentieth century they will constitute a third or more of the United States workforce. Knowledge workers require extensive formal education and the ability to acquire and apply theoretical and analytical knowledge. Like others, they will have to acquire the habit of continuous learning to remain productive.

Technology does not develop in a vacuum. Whether it is "pushing" society along or being "pulled" by societal forces, any examination of its effects on learning must first acknowledge the larger changes taking place in society to ensure that technological solutions are applied appropriately. The emerging global economy presents several distinct problems: (1) a mobile, dispersed workforce; (2)

displaced unskilled workers; and (3) an information-based economy requiring highly skilled (knowledge) workers . A highly educated, flexible workforce will be a necessity for the United States to remain competitive in the twenty-first century. It is clear that an educated person will be someone who has "learned how to learn" and who continues to learn throughout his or her lifetime (Drucker, 1994). Varied resources, innovative educational/training strategies and technologies foremost among them, will be required to meet these challenges.

Non-Traditional Learning Environments

The challenges inherent in the global economy affect all stages of education from the formative childhood years through college/university schooling to continuing professional and non-professional education. The notion of education as a formal process occurring at a specified location during a fixed time-frame is not adequate to meet the requirements of the twenty-first century. A paradigm shift in the operational concept of the teaching/learning process is a necessary prerequisite to adequately addressing future challenges. This is not to propose a zero sum game: abandon traditional education and embrace a world of virtual education. Instead, the paradigm suggested is one that integrates a new role for teacher and learner within traditional education and looks to identify transition areas where newer technologies can provide more effective learning environments.

Newly available tools for storing, accessing, creating, delivering, displaying and evaluating information are transforming the learning process. As networked information resources become more widely accessible, learning can occur anytime, anywhere (Twigg, 1994). When access to networked information is available in schools and integrated into curricula, several aspects of the learning environment are transformed. Most notably, students become active participants in learning rather than passive recipients, and teachers embrace a more active role in facilitating learning. Students assume more individual responsibility for achieving learning outcomes and explore alternative sources of information and knowledge. Students develop an understanding of how to use various tools to search and retrieve networked information. Additionally, they learn to manipulate information and to analyze and work with symbols. Teachers collaborate with networked peers and become active mentors, group project leaders and designers of learning experiences. Networked teams of teachers and students collaborate to apply interactive high performance technology to solve real-world problems, to retrieve information from electronic libraries, and perform scientific experiments in simulated environments.

Effectiveness studies of networked technologies in schools have demonstrated increased student-student and student-teacher interaction and increased student-teacher interaction with lower performing students without decreasing the use of more traditional forms of communication (Interactive, 1993; D'Souza, 1993) demonstrated that students who conscientiously use personal electronic mail as an additional means of self-reflection develop greater conceptual understanding of the subject. Additionally, hypermedia environments have been shown to afford students more insight into organizing and synthesizing information (Turner and Dipinto, 1992)

The accessibility of multimedia over networks is expected to extend the range of effectiveness of distance learning applications (Collis, 1991; Steinberg, 1992; Kaye, 1992). Furthermore, networks encourage: (1) cooperative distance learning among peer groups of remotely connected students; (2) an organizational framework for mentoring, apprenticeships, peer collaborations and (3) direct participation in scientific research (Civille, Fidelman, and Altobello, 1993). Ideas such as ubiquitous computing (Weiser, 1991) and the design of computer-supported cooperative work (Ishii, Kobayashi, and Arita, 1994) may provide the necessary ingredients to create a seamless web of media (text, video, audio, graphics, video-on demand and video conferencing) as part of a broadband National Information Infrastructure.

Networked applications reach beyond the schools and extend into the community of work where the integration of hardware and software connect workers with a vast array of information, training and employment services. Much needs to be accomplished to expand these services beyond their nascent stages into a seamless web of educational and training opportunities available during formative schooling and continuing into an adult cycle of productive "life-long learning".

National Information Infrastructure for Life-Long Learning

The creation of the National Information Infrastructure (NII) will effect many aspects of society: electronic commerce, agile manufacturing, government services, civic networking and life-long learning. The intent is to "integrate hardware and software skills to make it easy and affordable to connect people with each other, with computers, and with a vast array of services and information resources" (Civille, Fidelman, Altobello, 1993, p. 1). The remainder of this paper focuses on the availability, access, physical structure and processes of the NII relevant to applying distance learning concepts and technologies. It examines the generic issues of distance learning within the evolving framework of the NII with some specific examples of distance learning in schools, higher education and the health professions.

Universal Availability and Access

Without a public infrastructure that enables both the public and private worlds to expand and grow with the new technology, little real progress can be made in achieving a truly ubiquitous information society (Heldman, 1994). A framework of cooperation between government, academia, industry and key user groups is necessary to meet urgent societal needs, encourage research and innovation, and induce investment from the private sector (Weingarten, 1993).

Mason (1994) describes digital convergence as the most explosive technology confronting our community today. Mason's prescription for universal access to the ubiquitous, networked, multimedia promised by the NII has three basic components. According to Mason every community member should have: (1) a basic "kit" of information equipment for display, input and memory; (2) unrestricted access to the "public" information that is available and (3) basic usability or friendly interfaces to information.

Kapor and Weitzner (Kapor, 1993; Kapor and Weitzner, 1993) present an argument for the re-wiring of America that results in Jeffersonian networks promoting the openness, freedom and diversity that is the true promise of the technology. Their Jeffersonian ideal consist of: (1) increased bandwidth for all information sources; (2) open architecture/open standards; and (3) a model of control patterned on the Internet rather than on the broadcast model. Openness and cooperation between government and private enterprise are the crucial ingredients to ensure universal availability and access to the NII.

The federal government's role is properly perceived as that of: (1) facilitating private sector investment in infrastructure; (2) removing regulatory barriers, establishing standards, supporting research, prototyping and evaluating "benchmark" applications and (3) providing assistance to education and training communities (Gore, 1994). Government also properly communicates a vision for the education and life-long learning applications on the NII. State and local governments would be responsible for a large share of the investment in elementary, secondary and higher education. They are also in a position to remove regulatory and tariff barriers to NII access in local communities.

The private sector on the other hand has responsibility to: (1) build the telecommunications infrastructure and (2) provide the "lion's share of the nation's investment in applications for education and life-long learning. And finally, the private nonprofit groups remain as providers of information and technical assistance in such activities as "Free Nets" (best exemplified by the Cleveland Free Net).

Universal availability and access for all citizens is only ensured through an open platform concept (Electronic Frontier Foundation, gopher.harvard.edu, 1994). The Electronic Frontier Foundation defines an open platform as ranging from narrowband to broadband digitally switched services made available by a variety of providers over interconnected networks using a variety of transmission media: copper wire, coaxial cable, fiber optics and wireless. Criteria for an open platform include: (1) widely available switched digital connections at affordable prices; (2) open access to all without discrimination as to the content of message; (3) sufficient "upstream" capacity to enable users to originate, as well as receive good quality video and multimedia services. This last requirement cannot be overemphasized. As Balabanian (1994) points out in Computer Networks and Equity, the concept of access equity is broader than just equal access and must apply equally to the transmission of information.

Telecommunications

The existing telecommunications infrastructure consists of telephone, broadcast, satellite, cable and electronic networks. Education, training, and life-long learning applications consist mainly of (1) video instruction (one-way video and two-way audio and two-way video/audio); (2) information retrieval from databases/libraries; (3) two-way asynchronous applications such as email, listservs, bulletin boards, newsgroups; (4) electronic transfer of instructional software and simulations and (5) distance learning.

In the aggregate, these applications are representative of what Romiszowski (1993) identifies as the fourth phase in the development of distance education. One that is characterized by the use of advance telecommunications and computer-mediated-communication (CMC). The prior three phases were identified as: (1) a print-based model of correspondence education; (2) radio/television open broadcast with correspondence and print materials and (3) a variety of teleconferencing systems. Taylor (1992) and Miller (1992) identify similar phases in the development of distance education. They describe them as the correspondence model, the multimedia model and the telelearning model. Together these authors foresee a fourth phase of distance education dominated by computer-mediated-communication and advance technologies inexorably tied to the major events that are currently unfolding in the telecommunications marketplace.

The creation of the NII is driven by the convergence of hardware, software, networking technologies and the quest for digital data. The data highway's backbone will use every wide area communication technology known: fiber optics, satellites and microwaves (Reinhart, 1994). On-and off-ramps connecting users to the backbone will consist of fiber, coaxial cable, copper and wireless technologies. Network clients will be served by supercomputers, mainframes, minicomputers, microcomputers and massively parallel machines. Software interfaces to the network will consist of a new generation of "middleware" known as intelligent agents or knowbots (Roesler & Hawkins, 1994). Users will receive and send information on a variety of devices: information appliances, smart phones, personal digital assistants, set-top boxes/TVs and microcomputers.

According to Reinhart (1994) and Heldman (1994) protocols and bandwidth are the two main unresolved technical issues relevant to the data highway's architecture. Advanced protocols and increased bandwidth are crucial to establishing the full range of voice, data, text, images, high resolution video and interactive communications that are envisioned for the NII.

Major Components: Broadcast, Cable, Telcos, Networks

The technology components that will eventually constitute the NII currently exist as a disparate collection of products and services. These components are comprised primarily of broadcast services, cable companies, telcos (the seven regional Bell companies (RBOCs) and long distance companies) and various interconnected public and private electronic networks. Each component pursues its own commercial or public objectives and in most instances has its own communication protocols, information formats, and transmission capacity or bandwidth. Out of this varied mix of services and products must emerge a ubiquitous, affordable, easy to use, multipurpose, information rich and open NII.

The broadcast and cable companies represent an analog world of broadcast services with a point to multi-point topology. Together they provide a "gateway model" where information originates and is controlled at a central point and is broadcast simultaneously to multiple locations. Cable companies presently have limited capacity for "point" to "point" or two-way communication. Cable's strong suite is their installed base of broadband coaxial cable that passes ninety-seven percent of United States households (Cable Television Laboratories, 1994). Enhancements such as digital compression and "fiber to the curb or pedestal" (extending fiber beyond main trunk lines out into the neighborhoods) are transforming cable systems into high capacity digital transmission networks. The hybrid fiber and coaxial cable combination provides cable companies with the potential of providing interactive information services beyond the much "hyped" movies-on-demand. An example of this potential is seen in the recently announced joint venture between Tele-Communications, Inc. and Microsoft to deliver on-line services to personal computers via cable TV lines (Farhi, 1994).

Electric utilities also provide a potential source for a hybrid network of fiber and coaxial cable. Demand-side Management (DSM) is a plan for utilities to share a new distribution system with telephone and cable-TV companies that could carry two-way data, voice and video on a single line (Brunet 1995). The plan includes two components: (1) a hybrid network infrastructure of optical-fiber from the electrical utility office to a feeder location plus two-way coaxial cable from the feeder to residence and/or office; and, (2) a set of microprocessor-based devices--a gateway at the utility substation and intelligent interfaces at the residence or business. The DMS system would include multiple subsystems: one each for phone, data, and video services.

Telephone companies represent the world's largest circuit-switched distributed network designed for point-to-point communications. The Public Switched Telephone Network (PSTN) is a combination of technologies: fiber optics, copper wiring, satellite and microwave. Long distance carriers are responsible for the high speed lines interconnecting regional and national phone systems and for the Internet backbone.

The telephone network is being replaced with digital technology from the network on down to the customer premises. Two major issues under consideration will influence the development of the NII: (1) deployment of optical fiber to the customer premises at a cost of billions of dollars and (2) what services (such as video) in addition to voice will be allowed over the switched telephone network. Competition abounds among RBOCs, long distance providers and cable companies over the issues of local versus long distance services, value added services and delivery of video service to the home. Federal legislation will be required to resolve these competitive issues and most likely will result in more open competition among the major players.

In the minds of many, today's Internet stands as the model network to be emulated in the development of the National Information Infrastructure. The Internet represents an open system for communication where information has multiple points of origin and is sent over a distributed network of interconnected computers. It is perceived as a model because it stands in stark contrast to the concept of hub and spoke networks where information and services originate and are delivered from a central point.

The Internet is a highly successful and well regarded example of how multiple packet switching networks can be interconnected to form a network of networks. It is referred to as a network of networks because it is made up of networks interconnected by routers. Sometimes it is referred to as a "virtual network" because it presents the illusion of a single large network. This configuration has led to much success since the ability to connect multiple types of networks allows each group in an organization to choose a network technology that best suits the group's needs and budget (Comer, 1995). Its success is further exemplified in its extension into the National Research and Education Network (NREN) which has become a catalyst for the development of the high speed communications and information systems that will become the NII.

Software applications on the Internet use the same general structure know as client-server computing. The key communication protocol used on the Internet is called the Internet Protocol (IP). All computers that connect to the Internet must follow the rules of IP. Transmission Control Protocol or TCP is the companion software that provides reliable error-free communication. Together this communication protocol is known as TCP/IP. The National Science Foundation formed the backbone of the Internet up until 1992. Since 1992, a non-profit company called Advanced Networks and Services (ANS) comprised of IBM, MERIT, and MCI, has provided the high speed backbone for the Internet (Comer, 1995). ANS owns the transmission lines and computers that comprise the network. This event is seen by some as the first step toward the commercialization and privatization of the Internet.

Evolving Physical Infrastructure

How will these technology components and their attributes evolve into the National Information Infrastructure? Cerf (1991), Dertouzos (1991), Heldman (1994), Negroponte (1991) and Tesler (1991) offer some prudent observations in their writings on the subject of networked communications. Several technologies, some new, some not so new, appear in their writing. Integrated Digital Services Network

(ISDN), Asynchronous Transfer Mode (ATM), and Synchronous Optical Network (SONET) are among the most frequently mentioned technologies that impact on the development of future electronic networks. Satellite and wireless technologies are also perceived as a salient component of the overall architecture of the NII.

ISDN was conceived by the International Telegraph and Telephone Consultative Committee (CCITT) in 1971 as a scheme to replace the plain old telephone system (POTS) with an all digital network that integrated voice and data on a single subscriber line. ISDN is a network technology that provides a way of utilizing narrowband technology (N-ISDN) that enhances the installed base of copper wires for shared voice/data in a digital mode (64kbps-128kbps) and allows for phase in of broadband technology (B-ISDN) in the early stages of fiber development (Kaman,1993). Basic Rate ISDN offers speed of more than 100 kilobits per second over residential copper wire while Primary Rate ISDN offers more than a megabit per second using specialized copper access plant. The implementation of ISDN would maximize the use of existing copper plant requiring no change in customer premises wiring or equipment during the transition phases into broadband fiber optic technologies necessary to achieve the goals of the NII.

ISDN offers a framework within which existing analog networks can evolve to meet changing users needs for higher capacity broadband services (Heldman, 1994). Broadband-ISDN (B-ISDN) would replace the physical infrastructure of the public switched telephone network with optical fiber cable with transmission rates of 155 megabits to 2.4 gigabits per second. It would also utilize fast-packet switched protocols and make use of virtual channels that do not require a pre-specified bit rate. This ability to provide transport of information independent of its service type is referred to as band-width-on demand. Heldman (1994) also points out the importance of ISDN standards as numerous vendors attempt to understand and standardize various interfaces for the exchange of integrated voice, data, and video information in the form of bursty, fast packet, circuit and channel type transmission and switching. While not the definitive answer to achieving the goal of universal information services, ISDN offers a phased plan for proceeding into the future.

Asymmetric digital subscriber loop (ADSL) is another technology that phases in digital transmission over copper wires. ADSL permits transmission of a single compressed, high quality video signal (VCR quality) at a rate of 1.5 megabits per second in addition to ordinary voice phone conversations (Kapor,1993).

The framework for future high speed wide area digital networks is the photonic standard called Synchronous Optical Network or SONET. SONET supports a multiplexed hierarchy of transmission speeds of 51 megabits to 2,400 megabits per second and allows for multiplexing and demultiplexing varying data speeds without breaking down each stream into individual components (Cerf, 1991). Photonic switching research promises optical switching machines with a terabit or 1 trillion bits per second. Such capacity will be necessary in the future for transmission and retrieval of massive amounts of high resolution video and three-dimensional images.

Asynchronous Transfer Mode (ATM) is fast becoming a world wide digital communication standard. ATM is poised to become the communication technology protocol of the future (Heldman, 1994). Its strengths are flexibility and speed. ATM can handle real-time traffic like voice and video and is also effective for more traditional data communication. ATMs fixed length 53 byte cells allows the integration of data media operating at different rates. This predictability allows scalable network performance. Although it can run on just about any medium, ATM was developed with the intention to run on fiber-optic networks as defined by SONET a US standard and (SDH) synchronous digital hierarchy, a European standard.

ATM is the first technology to provide a common format (cell) for bursts of high speed data and the ebb and flow of the typical phone call. ATM is scalable and equally at home in any network, local or wide, public or private (Heldman,1994). Given its attributes, ATM could erase the distinction between local area networks (LANS) and wide area networks (WANS) to provide the widely sought after goal of seamless networking.

Wireless networking, which permits continuous access to the services and resources of land-based networks (Forman and Zahorjan, 1994), also will be an important technology component of the infrastructure. Communication on wireless networks is via modulating radio waves or pulsing infrared light. Wireless communication is linked to the wired network infrastructure by stationary transceivers. This mobile computing capability provides a technology that enables access to digital resources at any time from any location.

Although growing rapidly--to the tune of sixteen billion dollars in licensing fees to the FCC for personal communication services (PCS) bandwidths (Arnst, 1995), wireless technology is not without problems. It is characterized by low bandwidth and is subject to high error rates and surrounding environmental interference. Current R & D efforts supported by telecommunications companies are aimed at solving these problems. The recent promising development of code division multiple access (CDMA) allows wireless systems to have ten times the capacity of old wireless systems. By limiting the time-and-place restrictions inherent in desktop computers and wired networks, the potential of mobile computing increases user accessibility to network services around the world.

Satellites, Instructional Television Fixed Services (ITFS) and microwave technologies currently provide alternative delivery systems for instructional programming to the public schools (Lane, 1993). Although primarily analog in nature these technologies will be integrated into the emerging digital information infrastructure. Several factors portend this integration.

Geosynchronous satellites (those in an orbit equivalent to the earth's rotation) provide "store and forward" applications such as computer conferencing and voice mail. Additional applications will be forthcoming from Motorola Inc.'s (Iridium) and Comsat's global satellite communications programs. Recently, Teledesic Corp (a Microsoft and McCaw Cellular Communications Inc. start-up company) announced its intentions to provide a network of 840 satellites to bring telecommunications to remote areas around the world by the year 2001 (Sugawara, 1994). Teledesic embraces the technology developed under the Strategic Defense Initiative's "brilliant pebbles" program. Other developments such as Direct Broadcast Satellite (DBS) and the recently announced Digital Satellite Services (DSS) offer digital programming to small receiver dishes (ranging from three feet to eighteen inches in diameter) conveniently located at consumer's homes. As these services penetrate the home market it becomes increasingly clear that they will inevitably merge with the NII.

The technology blueprint for the future will involve the application of common standards and communication protocols to interconnect local and wide area networks linking people together over a National Information Infrastructure. Open Systems Interconnection (OSI) seven layer architectural reference model and standard for communications among computers and terminals will provide the evolving guide for this blueprint. Fast-packet architectures will be the key to this development and will be part of both public and private networks. The resulting integrated networked environment will appear as a "virtual" network for the end user, broadening communication, giving users access to varied applications and hopefully reducing overall costs (McGee, 1994).

Asynchronous Transfer Mode (ATM) appears to be the protocol of choice for full multimedia capabilities. McGee (1994) predicts that the focus of the networking industry for the rest of this decade will be dominated by the

integration and evolution of today's multiple, specialized technologies into a fewer number of higher speed, multidimensional technologies.

The litmus test of the technologies that represent the information infrastructure ultimately, will not be judged by bandwidth capacity or number of executable operations per second but rather by the character of its content. The remainder of this paper explores potential content in the civic and education arena, with special emphasis on distance learning.

Distance Learning Opportunities

Community Services Networks

Many opportunities for networked community services are outlined in A National Strategy for Civic Networking : A Vision of Change (Civille, Fidelman, & Altobello, October 1993). Their review is replete with examples of networked applications that cut across all aspects of civic, education, health, work, and community activities. The projects reviewed are exemplary of the salutary and empowering effects of a national strategy for civic networking predicated on a National Information Infrastructure. They illustrate how integrated networks are able to provide endless opportunities for resource sharing and collaboration among individuals and communities. Two of the most prominently mentioned projects are: the Blacksburg Electronic Village and Smart Valley.

Blacksburg Electronic Village in southwestern Virginia, is a testbed for the delivery of business, community, education, health, and library services over narrow and broadband ISDN networks. This project attempts to enhance the quality of people's lives by electronically linking the residents of the community to each other and to worldwide networks. Blacksburg has become a laboratory to develop a prototype for the concept of a National Information Infrastructure. A hallmark of this experiment is its emphasis on interactions between people rather than focusing on specific technologies. A Local Research and Education Network (LREN) is envisioned for educational uses. This local network would connect to the developing National Research and Education Network for access to database and increased access to other students, teachers and researchers. The community of Smart Valley, in Palo Alto, California, is also envisioned to develop an electronic community that will benefit all sectors of the community: education, healthcare, local government, business and home applications.

An important ingredient of both these projects is the "bottom up" approach to designing the testbed networks. Instead of a "top down" systems rule approach, the individual needs and desires of community members are guiding the development of the integrated networks and services. As Gilder (1994) has pointed out networks should be allowed to evolve as an organic process and grow from needs rather than be imposed from the top. Advances in technology will be more secure, enduring and profitable if they result from careful examination of user requirements and needs.

Distance Learning Initiatives

Plans to use the National Information Infrastructure for education and life-long learning address the challenges of the emerging global information economy identified in a previous section of this paper. Federal, state and local governments and private business have initiated programs to set the stage for meeting these challenges. Several programs in the federal government (Aeronautics & Space, Energy, Federal Communications Commission, Housing and Urban Development, Interior, and the Office of Science and Technology Policy) have launched initiatives (Gore, 1994).

These initiatives involve: (1) developing K-12 computing and communication applications supporting a new learning paradigm; (2) the development of digital libraries to utilize distributed databases around the nation and the world; (3) training programs to use the NII to enhance the skills, education and training of the American workforce; (4) distributing K-12 curriculum over the Internet; (5) regulations for reasonable rates for telecommunications by radio, television, wire, satellite and cable; (6) establishing a high speed communications infrastructure for research and educational use (NREN) and (7) the development of software, interfaces, and tools necessary for the educational use of the NII.

Current initiatives to develop the communication technologies and tools for the "information age" have the potential to revolutionize traditional educational environments and practices. Traditional educational settings where learners are passive recipients of information provided in lecture formats or from linear printed materials are fast giving way to computer-mediated-communication of multimedia information over local, metropolitan and wide area networks. Such environments change the focus from teacher control to learner control, and from highly structured learning to flexible and responsive settings that offer varied learner options. Linear presentation gives way to random access; passive attendance to active participation; rote learning to developing problem solving competency and independent thinking; information assimilation to knowledge construction; classroom facilities to authentic simulated environments. This transition from a "teaching environment" to a "learning environment" sets the stage upon which school-based and workplace learners will encounter opportunities for life-long learning.

These initiatives, we believe, signify a need to expand our perception of distance learning to encompass the opportunity for life-long learning provided by a variety of telecommunication technologies, and especially computer-mediated-communication (CMC) over the Internet.

Indications that these opportunities are increasing are evident in the public sector increase in the number and variety of on-line information services and in the tremendous growth in the multimedia software publishing business. The "big three" on-line services: Prodigy, Compuserve and America on-line now claim more than three million subscribers among them. It is predicted that on-line subscriptions will grow another thirty percent in 1994 (Eng, 1994). Sales of home learning multimedia software will reach 250 million in 1994 and are expected to reach one billion by the end of the decade (Armstrong et al., 1994). Interactivity, defined as active involvement and control by participant or learner with the entertainment or educational product is a key ingredient to the success of these two industries. The merging of computers, telephones, satellites, cable, television and wireless technologies into a transparent web of networks making a vast array of information available to homes, schools and businesses is another.

Networked multimedia applications in the commercial and home market are out pacing similar applications in the schools. The good news is that the commercial and home market applications are part of the evolving information infrastructure that is beginning to penetrate the educational market. In 1987, fewer than ten states were investing in distance learning. By 1988 two-thirds of the states reported involvement in distance learning projects (U.S. Congress, 1989).

Several ongoing programs exemplify the potential for educational applications. The Global Access Information Network (GAIN) is a project of NYSERNET, a mid-level Internet service provider in New York. The project is supported by the Apple Library of Tomorrow and private foundations. GAIN provides Internet services to five public libraries and an Indian Nation school. In addition to collaboration between local libraries and local schools, the community has benefitted from access to medical information. The National Capital Area Public Access Network (CapAccess) in Washington, D.C. works with public school librarians over a three state area. (CapAccess) provides free Internet accounts to students who use Internet mail to subscribe to school topics of interest. In Montana, the Big Sky Telegraph project links schools and libraries enabling students to study Russian with Russian pen pals oversees and to study chaos theory with scientists from the Massachusetts Institute of Technology.

High Performance Computing and Communications (HPCC) programs have spawned some exciting distance learning projects as part of the InFoMall concept (Mills and Fox, 1994). InFoMall is a program led by the Northeast Parallel Architectures Center (NPAC) to create an innovative technology transfer program for the "information age". It is intended to address the problem of HPCC software development in the "real world" of industry, education and society. The (NPAC) InFoMall is charged with converting the United States lead in HPCC technology into a global economic competitive advantage and into corresponding benefits in health care, education and society in general.

NPAC plans two demonstration projects in education through the implementation of NYNET. NYNET is a high-speed, fiber-optic communications network, based on Asynchronous Transfer Mode (ATM) technology. NYNET will interconnect multiple computing, communications and research facilities in New York State. The first demonstration project will repackage Grand Challenge scientific simulations into educational modules for school age children. The modules will run on high performance computers at NPAC and will be distributed to schools over the NYNET high-speed network. Students and teachers will become interactively engaged with the simulations and manipulate "real world" variables. The second project is titled "The Interactive Journey" and will allow interactive "real-time" tours of New York State based on LANDSAT satellite images. Students and teachers will navigate through three dimensional space and manipulate archeological, geological, environmental, business and demographic variables.

Networked applications of distance learning are occurring with increasing frequency over the Internet. Paulsen (1995) organizes computer-mediated-communication (CMC) according to four communication paradigms: information retrieval; electronic mail; bulletin boards and computer conferencing. He further elaborates on this scheme by including a dimension of interactivity distinguishing among: one-alone; one to one; one to many and many to many. This scheme allows a matrix approach for determining the interrelationship between type of communication and level of interactivity which is a useful tool for planning and designing specific learning experiences based on intended outcomes.

Chris Dede (1993) proposes a broader conceptual scheme for educational uses of the NII that includes knowledge utilities, virtual communities and synthetic environments. Dede's framework acknowledges the links between workplace and school-based learning that are necessary to address the transformation of work brought about by the knowledge-based economy. Dede attempts to explore interactive services that meet the needs of both workplace and school-based learners. His framework relies on collaborative learning and recognizes the necessity for integrating interpersonal with technology mediated communication.

Dede's concept of a "virtual forum for learning" is in response to his perceived need for a workforce trained in ad hoc or "just-in-time" decision making and continual learning-while-doing on the job. Dede predicts that three types of applications will come to dominate distance learning provided by distributed desktop computers over wide area, high-bandwidth networks: (1) learning by assimilation; (2) learning by analogizing and (3) learning by doing. Dede's scheme capitalizes on the NII through a "virtual forum for learning" that leverages emerging technological capabilities to promote learning-on-demand within school-based and the evolving workplace environment (Dede, 1993, p. 6).

Rheingold (1993), Savetz (1994) and Weiser (1994) promote the potential of MUDs (Multi-User Dungeons or Multi-User Dialogues or Domains) as a distance learning application of "virtual communities". MUDs are typically computer programs that users log into and explore for recreational purposes. MUDs have been in existence for about ten years, the first one modeled on a Tolkienesque domain of dwarfs and treasure, warriors and wizards, swordplay and magic known as "the Land" (Rheingold 1993, p. 155). Recently, networked educational applications of MUDs have appeared. Most notably, the Jupiter Project, MediaMOO and Virtual Online University (VOU). Each of these projects is described as a MOO (a Multi-User Dimension or object oriented environment). They are database programs running on servers that allow users remote access to become active learners in a text-based virtual reality. As such, they provide a casual environment integrating virtual and real worlds. Many other applications of MUDs provide a variety of electronic classrooms, electronic tutorials and seminars.

Project Jupiter is a multimedia, international MUD intended as a working tool for designers of virtual workplaces of the future (Rheingold, 1993). MediaMOO created in 1993, is a virtual version of MIT's Media Laboratory. Virtual Online University (VOU) is the first virtual online university on the Internet (beta test begun September, 1994) (R. Donnelly, personal E-mail communication, September 7, 1994). VOU is a model for a Virtual Education Environment (VEE) that combines the academic environment of a physical world university, the wide reach of the Internet and the creative environment of a MUD.

Other networked distance learning applications build upon the "peer to peer" distributed computer environment of the Internet. The client/server functionality of this distributed environment provides individual access from microcomputers and workstations to a wide variety of information/education resources. Individuals access and interact with these resources with the four basic Internet services: e-mail; Telnet (remote login); FTP (file transfer protocol) and browsers (Gopher, Mosaic, and others). A plethora of resources are available using these tools. Until recently, however, few educational applications were available. Resources were largely information and reference databases organized for access, retrieval and research purposes. This has changed with the recent interest and development of the World Wide Web (WWW).

The World Wide Web is a hypertext-based system for finding and accessing Internet resources (Krol, 1994). Use of the World Wide Web accelerated with the development and introduction of Mosaic, a multimedia interface (browser) to Internet Resources. Web servers have doubled every four months over the three years between April 1991 and April 1994 (Berners-Lee et al., 1994) Mosaic is a hypermedia tool that has the capacity for handling, along with text, audio, still images and motion video. Mosaic executes multiple communication protocols through Uniform Resource Locators and is platform independent. Because of this functionality and its graphical user interface (GUI), Mosaic sparked an enormous interest in creating World Wide Web sites (programs running on server computers) that provided opportunities for multimedia distance learning. The popularity and impact of Mosaic has spawned the creation of other GUI browsers or clients for accessing Internet resources.

It seems fair to say that the multimedia capability of the World Wide Web browsers was the primary incentive motivating faculty and students to create distance learning activities on the WWW. Suffice it to say, that these distance learning opportunities are appearing with a frequency that makes it difficult to systematically document and access each application. For example the authors have identified and documented numerous distance applications in the health sciences as of November 1994 as part of an ongoing project. These applications have been documented as: (1) hypertext databases text only (2) hypertext databases text and images; (3) medical image reference databases; (4) case-based medical image databases and (5) multimedia databases. The levels of interactivity provided for the learner include simple hypertext retrieval, analysis of clinical images, observation of surgical and other medical procedures (QuickTime and MPEG movies) and interactive feedback (email) of patient case evaluations. Anyone with Internet access and a WWW graphical browser can review these specific distance learning applications at the following Web site (http://wwwetb.nlm.nih.gov/).

The potential for networked collaborative on-line distance learning can be gleaned from the nascent MBone or "virtual network" that has been in existence since early 1992 (Macedonia and Brutzman 1994). MBone is an acronym for Multicast Backbone. MBone originated from the University of Southern California Information Sciences Institutes efforts to multicast audio and video from meetings of the Engineering Task Force. Multicast makes possible one-to-many and many-to-many network delivery services for applications such as videoconferencing and audio where several hosts need to communicate simultaneously (Macedonia and Brutzman 1994, p. 30). Hundreds of researchers currently use MBone to develop protocols and applications for group communication.

Multicasting has become feasible on the Internet as the result of: (1) high bandwidth Internet backbone connections and (2) widespread availability of workstations possessing adequate processing power and built-in audio capacity. Several distance learning applications have occurred using MBone: (1) conferences on supercomputing and scientific visualization; (2) Radio Free VAT; (3) Internet Talk Radio and (4) other remote learning activities such as the Jason Project and the Naval Postgraduate School Visualization Laboratory. In practice, MBone provides only one to four frames of video per second (compared with standard video of 30 frames per second) accompanied by phone quality voice. Nevertheless, MBone may be the precursor to the high bandwidth networked multimedia applications promised by the NII.

Opportunities in the Health Professions

Several major infrastructure initiatives are specifically relevant to health professions education: The Integrated Advanced Information Management Systems (IAIMS), the multi-agency High Performance Computing and Communications (HPCC) programs and the National Research and Education Network (Lindberg, 1993).

The IAIMS is a National Library of Medicine initiative begun in 1983 to promote the development of integrated computerized communications systems across academic health science institutions that would link library systems with individual and institutional databases for patient care, research, education and administration. This proved to be a forward looking initiative: IAIMS participants were the early pioneers of medical networking who experimented with and integrated information technologies in a medical environment that were the precursors to current efforts to create the NII.

Among the many goals of HPCC, the development of the National Research and Education Network (NREN) and the gigabit testbeds for advanced networking are particularly pertinent to the issues discussed in this paper (High Performance Computing and Communications, 1994). Both research and education will be advanced by efforts to connect health professional to computerized information resources involving medical imaging, biotechnology and information-retrieval tools. The advanced networking projects support six collaborative testbeds for research on very high-speed networks. Universities, national laboratories, supercomputer centers and industry are participating in this collaboration. The major goal of this collaboration is to remove current barriers to the efficient delivery of huge multimedia files in a shared high performance computing environment.

HPCC also supports projects in telemedicine and digital libraries. As part of this program the National Library of Medicine supports Internet connection grants to provide support for currently available services over the Internet. The goal for 1995 is to connect 70 to 100 medical centers to the Internet. This encourages baseline practical experience with current services and hopefully provides incentives for involvement with the imminent advanced network technologies.

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These initiatives, coupled with the technological advances in the commercial telecommunications market will have an enormous influence on: (1) the clinical practice of medicine; (2) the formal education of health professionals and (3) the creation and delivery of continuing professional education.

Some Final Thoughts on the Future of Distance Learning

School, home-based and workplace distance learning opportunities will abound with the advent of the National Information Infrastructure. If the ideal of universal access (equity in access and transmission and "common carriage" or subsidized access for those who cannot afford it) is achieved the groundwork will have been established for participation by all citizens. To ensure universal participation and the achievement of the distance learning goals projected for the NII, four issues in particular require attention : (1) technology's consequences; (2) quality/relevant content; (3) purposefulness and (4) literacy. Vigilance for technology's consequences, both anticipated and unanticipated, is foremost among them. Gilder (1994), Norman (1993), Papert (1992), Postman (1992), Zuboff (1988) and others have written eloquently on the subject of technology's consequences for the design of human-machine interaction, school, home and work-based activities and the larger culture. An enormous technological implementation such as the NII is predicted to have far reaching consequences not all of which are intended or anticipated.

Individuals and institutions will have to make accommodations to technology's consequences. In the area of distance learning fundamental questions will have to be examined with regard to: (1) quality/type of content; (2)design/delivery of content; (3) teacher role/compensation; (4) student responsibilities; (5) continued teacher training; (6) role of colleges and universities/credentials/degree granting; (7) student selection/cross state and country regulations and many more (Jacobson 1994). Careful documentation and assessment of the changes brought about by these accommodations should be a significant ongoing component of an overall plan for the NII. Special emphasis should be placed on monitoring the unanticipated effects and planning for timely and effective responses. Vigilance for consequences will increase the probability that the emerging NII will achieve its intended goals.

Content, purposefulness, and literacy are inextricably bound together. Together these three variables will play a significant role in making universal access meaningful and ensuring the effectiveness of distance learning applications. It is not adequate simply for technology to provide high tech conduits for transferring information. The content traversing the conduits must be of high quality and relevant to enhancing the requisite knowledge and skills of the end user. The end user in turn must possess an abiding purpose for accessing, retrieving and utilizing the information, and most importantly, fundamental literacy and information technology skills.

In the case of distance learning, the issues and concerns relevant to content, purposefulness and literacy skills to a great extent will determine the success of the National Information Infrastructure for the average citizen.

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Title:

Situated Instructional Design: Blurring the Distinctions Between Theory and Practice, Design and Implementation, Curriculum and Instruction

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Situated instructional design could mean a couple of different things:

1. The kind of instructional design (ID) that rests upon a situated-cognition view of human learning and performance. Situated cognition is a powerful metaphor for human learning that incorporates elements of everyday cognition, informal learning, authentic learning experiences, and cultural influences (Brown, Collins, & Duguid, 1989). Many ID theorists are heavily influenced by situated cognition and constructivism (e.g., Wilson & Cole, 1991, in press), resulting in corresponding changes in ID prescriptions.
2. The kind of ID that adapts itself to the constraints of particular situations in ways that traditional ID models do not. Traditional ID is sometimes criticized for being overly proceduralized and rigid. A situated approach to ID would be more sensitive to local conditions in prescribing both methods and outcomes for instructional design.

I have in mind a view of situated ID that incorporates both of these notions. Much of the literature on constructivist ID relates to the first emphasis, while methodological critiques (e.g., Winn, 1990; Wilson, Jonassen, & Cole, 1993) relate more to the second emphasis. Thus situated ID may be seen as an approach that incorporates a constructivist, situated view of learning and expertise, while at the same time viewing the ID process itself in situated terms.

My purpose in this paper is twofold:

1. to offer several reflections about the relationship between design and implementation of learning environments and instructional products; and
2. to offer a number of specific recommendations for practicing ID from a situated/constructivist perspective.

SITUATED DESIGN: BLURRING THE DISTINCTIONS

Several points of reflection are offered in this section pertaining to the practice of instruction design as it relates to real-world contexts.

1. *Implementation and design are ultimately inseparable.* Some of the most valuable lessons learned about instructional design comes from the experience gained in setting up and administering programs. Real-world implementation can be just as important as theory-guided design.

An example may be taken from the 1970s research in computer-assisted instruction. One program, the TICCIT project, was shown by an NSF evaluation to achieve its objectives more successfully than traditional classroom instruction (Merrill, Schneider, & Fletcher, 1979). The program failed, however, in getting students to stay with the program; the dropout rate was unacceptably high when compared to traditional classrooms. In this case, the actual development and tryout of a program produced knowledge that was not anticipated ahead of time.

Another example is Clancey's Guidon-Manage research in intelligent tutoring systems (ITS). In a remarkable example of self-reflection, Clancey (1993) concludes: "After more than a decade, I felt that I could no longer continue saying that I was developing instructional programs for medicine because not a single program I worked on was in routine use..." (p. 7). This lack of successful implementation was attributable to the researchers' emphasis on the design of systems at the expense of meeting the needs of identified groups of practitioners. While Clancey and colleagues were successful in the development of improved methods of knowledge representation, they clearly failed in getting practitioners to notice. "*[R]esearchers must participate in the community they wish to influence*....[S]ome members of our research community must necessarily broaden their goals from developing representational tools to *changing practice*—changing how people interact and changing their lives... (p. 9, italics retained). Clancey reflects on how he might approach the Guidon-Manage research differently today:

- participating with users in multidisciplinary design teams versus viewing teachers and students as my subjects,
- adopting a global view of the context...instead of delivering a program in a...box,
- being committed to provide cost-effective solutions for real problems versus imposing my research agenda on another community,
- facilitating conversations between people versus only automating human roles,...
- relating...ITS computer systems to...everyday practice...versus viewing models...as constituting the essence of expert knowledge that is to be transferred to a student, and
- viewing the group as a psychological unit versus modeling only individual behavior. (Clancey, 1993, p. 17)

Clancey's ITS work was research with a design focus. Although the specific agenda is different, the lessons Clancey learned apply very well to users of ID models. Instructional designers, too, should "participate in the community they wish to influence."

Like the TICCIT and Guidon projects, design innovations sometimes result in negative outcomes. Failures of ID projects, however, become particularly valuable items because they can indicate areas of weakness not just in the current project but in the ID model underlying the project. Information gleaned from negative findings can serve as formative evaluation data, feeding back into future implementations of the model and into future version of the model itself.

2.*Questions of curriculum and value are central.* Perkins (1992) warns of a common fallacy implied by the statement: "What we need is a new and better method. If only we had improved ways of inculcating knowledge or inducing youngsters to learn, we would attain the precise...outcomes we cherish" (p. 44). Instead, Perkins believes that "given reasonably sound methods, the most powerful choice we can make concerns not method but curriculum—not how we teach but what we choose to try to teach" (p. 44). This comment reaffirms that a fundamental step in instructional design involves the serious consideration of learning goals. A variety of constituencies should be included in this process, including sponsors and members of the learning community itself. Once consensus is reached about the *kind* of learning being sought, certain teaching models become unfeasible while others become more attractive.

As Reigeluth (1983) acknowledges, curriculum and instruction cannot be completely separated. There is a tendency among many institutions to give lip service to higher-order outcomes while maintaining teaching methods that specifically suppress such outcomes. Medical schools that teach students to simply memorize and take tests are an example. Another example is a military school whose mission statement prizes "creativity" in students, yet whose teaching mehtods and authoritarian culture strictly reinforce conformity and transmission of content.

A basic lesson learne from observing schools is that two teachers may be covering the same ostensive curriculum while what *really* is taught differs raically between them. At its base, the constructivist movement in education involves curriculum reform, a rethinking of what it means to know something. A constructivist curriculum is reflected in many of the design innovations being discussed in the literature (Hanaffin, 1992). Thus, if a commitment is made toward rethinking curriculum to expand the roles of knowledge construction and learning communities, then a corresponding commitment needs to be made in rethinking learning activities. Deciding upon a teaching strategy is not a value-neutral activity. Recognizing this puts the selection of an ID model squarely into the political realm of policymaking. New issues become important, such as access, equity, representation, voice, and achieving consensus amid diverse perspectives.

3. *Deciding upon a design solution and making decisions within that framework is a highly situated activity.* The success of a given implementation will depend more on the local variables than on the general variables contained in the ID model chosen to guide design. Put another way, "the devil is in the details." There is a way to succeed and a way to fail using a whole host of teaching models. Teachers and students must see the sense of what they are doing, come to believe in the efficacy of the program, and work hard to ensure that the right outcomes—that is, outcomes that are consensually agreed upon—are achieved.

This situational perspective conflicts with traditional views. Thinking of instructional design as a technology would lead us to think that a situation gets analyzed, which leads to a technical fix to be implemented, which leads either to a measured solution to the problem or a revision in the fix for the next cycle of intervention. A situated view of instructional design would lead to a different process, something perhaps like this:

1. A learning community examines and negotiates its own values, desired outcomes, and acceptable conventions and practices.
2. The learning community plans for and engages in knowledge-generating activities within the established framework of goals, conventions, and practices.
3. Members of the learning community, including both teachers and students, observe and monitor learning and make needed adjustments to support each other in their learning activities.
4. Participants occasionally re-examine negotiated learning goals and activities for the purpose of improving learning and maintaining a vital community of motivated learners. This may lead to new goals and methods and cultural changes at all levels, from cosmetic to foundational.

This situated, community-oriented view of instruction takes a more holistic view to the design of instruction. The community is opportunistic in addressing "design" issues at any stage of planning and implementation. Community members, including students, have some voice in determining what happens to them in instruction. In return, they must show the needed commitment and disposition to behave responsibly and in support of learning.

If community members have participated in the establishment of a program, they are more likely to believe in it. If they believe in the program, the chances of success increase dramatically. As Perkins (1992) suggests, even very imperfect instructional methods can work if the commitment is made to work together and ask the right questions in designing curriculum.

analysis—implicit or explicit—happens in designing educational programs. A survey of instructional models reveals that some have demonstrably high development costs. *Sherlock* , an electronics troubleshooting tutor developed for the military, has taken a decade of patient research to achieve its present form (Gott, Lesgold, & Kane, in press), resulting in impressive learning gains. Once developed, however, the program may be replicated at a reasonable cost. Other models, such as problem-based learning, may pose heavy demands in terms of time in the curriculum (cf. Savery & Duffy, in press). Instructional designers (or learning-community members) must then face the question of how and whether to implement such resource-demanding teaching methods into an existing system and curriculum.

Every decision to adopt one teaching approach over another involves such weighing of pros and cons. However, while costs may be objectively measured and estimated, learning benefits are notoriously difficult to reduce down to a number. This inequity of measurability results in a common bias: The cost differences become exaggerated while the potential benefits, because they are harder to measure, tend to be undervalued or ignored. Comparison of alternative teaching models must give full consideration to qualitative differences in learning outcomes in addition to the more visible cost differences in time and money.

Some ideas may be borrowed and inexpensively incorporated into related products or programs. For example, if an instructor becomes excited by Schank's case-based scenarios (Schank, Fano, Bell, & Jona, 1993/94), she may choose to incorporate case histories and classroom simulations into her teaching. While the resulting lessons may bear only a passing resemblance to the computer-based scenarios, they are heavily influenced by Schank's principles of case-based, interactive instruction. Many important design principles, including those of cognitive apprenticeships and intentional learning communities, can be efficiently adapted into instruction in a number of ways, depending on local circumstances and resources.

5.*Instruction should support learners as they become efficient in procedural performance and deliberate in their self-reflection and understanding.* Most current ID theories emphasize the grounding of instruction in complex problems, cases, or performance opportunities. Yet organizing instruction around problems and cases should not mask the importance of perception, reflection, and metacognitive activity. Indeed, these two aspects of human performance (problem solving and perception) can be seen as inherently complementary and equally necessary. Experts are more than mere automatic problem-solvers. Rather, experts become experts through a progressive series of encounters with the domain, each involving an element of routine performance and a corresponding element of reflection and deliberation. This is the process of expertise spoken of by Scardamalia and Bereiter (1994).

Prawat (1993) makes this point well. While there is a tendency among cognitive psychologists to make problem solving central to all cognition, Prawat reminds us that schemas, ideas, and perceptual processes hold an equally important place. *Learning how to see* —from a variety of points of view—is as important as solving a problem once we do see. Principles of perception, whether from ecological psychology (Allen and Ott, in press), connectionism, or aesthetics, need to have a place within successful ID models. This includes teaching students how to represent problems and situations, but also how to appreciate and respond to the aesthetic side of the subject, how to reflect upon one's actions, and how to "raise one's consciousness" and recognize recurring themes and patterns in behavior and interactions.

6.*Successful programs must seek to make complex performance do-able while avoiding the pitfalls of simplistic proceduralization.* The art of "scaffolding" complex performance is a key problem area that surprisingly is still not well understood. How does a coach entice a young gymnast to perform just beyond her capacities, overcoming the fear and uncertainty that normally accompany new performances? How does the coach know just when and where to step in, preserving the integrity of the task (and the learning) while not letting the athlete fall on her head? These are questions of appropriate scaffolding or support for learning. Once a teacher begins believing the constructivist agenda and the importance of authentic, meaningful tasks, then the challenge of supporting novice performance within a complex environment becomes a central concern. As Sweller's (1989) research makes clear, poorly supported problem-solving activities force learners to rely on weak methods that they already know. The result is a lot of wasted time and frustrated learners. Appropriate and wise scaffolding makes problem-solving activities more efficient because learners stay focused within the critical "development" zone between previously mastered knowledge and skills beyond their reach (Vygotsky, 1978). Developing a technology for optimizing this kind of support is an area in need of further research and development.

This same concept of scaffolding can be directed to the implementation of ID models themselves. Instructional designers and teachers need proper supports and aids in designing according to a particular model or tradition. At the same time, they should be cautioned against simplistically "applying" a model in a proceduralized or objectivist fashion. Postmodernists would say that in such cases, the model "does violence" to the situation. The complexities of a situation should not be reduced down to the simple maxims of a teaching model. Any model that is forced upon a situation and made to fit, will lead inevitably to unintended negative consequences. The negative fallout will happen at those points of disjuncture or lack of fit between model and situation. As I have stressed, the details of the situation need to be respected and taken into account when adapting a model to a situation.

This, perhaps, is a more appropriate way of thinking about implementation: Rather than *applying* a particular instructional theory, a teacher necessarily *adapts* that theory to present circumstances. Learning how to adapt abstractions to concrete realities is a worthy task for both students and teachers, and indeed, may lie at the heart of some forms of expertise. This process of adaptation and using conceptual models as tools in a given situation is an essential ingredient of a situated approach to instructional design.

MANAGING CONSTRAINTS TO DESIGN

Consider what it means to design something (e.g., to fashion something from a well-developed plan). ID shares with all design activities the challenge of creating something that accomplishes a given purpose within the constraints and parameters of the situation. Constraints are a natural part of the creative design process, despite our yearnings for unlimited budgets, motivated learners, and relaxed deadlines. The realities of the situation, the goals of instruction, and limited resources constitute the "raw material" from which effective designs can take shape (Wedman & Tessmer, 1991). Failure to consider key constraints can result in the failure of a project.

On the other hand, ID sometimes imposes unnecessary constraints upon itself (Thiagarajan, 1976; Rowland, 1993). Is ID always served by a plodding, linear methodology, a rigid taxonomy of learning outcomes, or a fixed pool of instructional strategies? Such internally imposed constraints can become an obstacle to creativity and an unnecessary burden to the practitioner and to learners. Rapid prototyping (Tripp & Bichelmeyer, 1990) is an example of an innovation that changes the sequence of design steps, allowing the designer to redefine ID processes to better suit the situation and the tools available. The trick, of course, is knowing which constraints are genuine and which can safely be discarded as new possibilities present themselves.

Traditional ID models succeed largely because they help in the management of a team of workers engaged in a complex project. The critical management functions of monitoring work and ensuring accountability are handled by a set of checkpoints or signoffs—with little regard for their impact on the design process itself. Indeed, management goals and design goals are often in tension with each other. For an ID model to work in the real world, it must combine these two critical functions into a workable methodology: effective, creative design and efficient management and control, as illustrated below:

Effective Creative Design

- What do the learners learn—really?
- Are learners motivated by instruction? Do they see the value and relevance of instruction?
- Do learners use their knowledge to solve problems in authentic performance settings?
- Are learning environments rich in information, guidance, and support?

Efficient Management and Control

- Will the instructional product reflect a return on investment?
- Is the development process efficient? Are resources being well utilized throughout the design process?
- Is there systematic planning, decision-making, and accountability in the design process?

Table 1. Two competing functions of instructional design models.

Because of the tension between these competing functions, one will often predominate over the other. If the management function is emphasized, the project may come in under budget, but tend toward mediocre strategies and mundane learning outcomes. If creative design dominates, the project may be pathbreaking but remain forever in a state of partial completion.

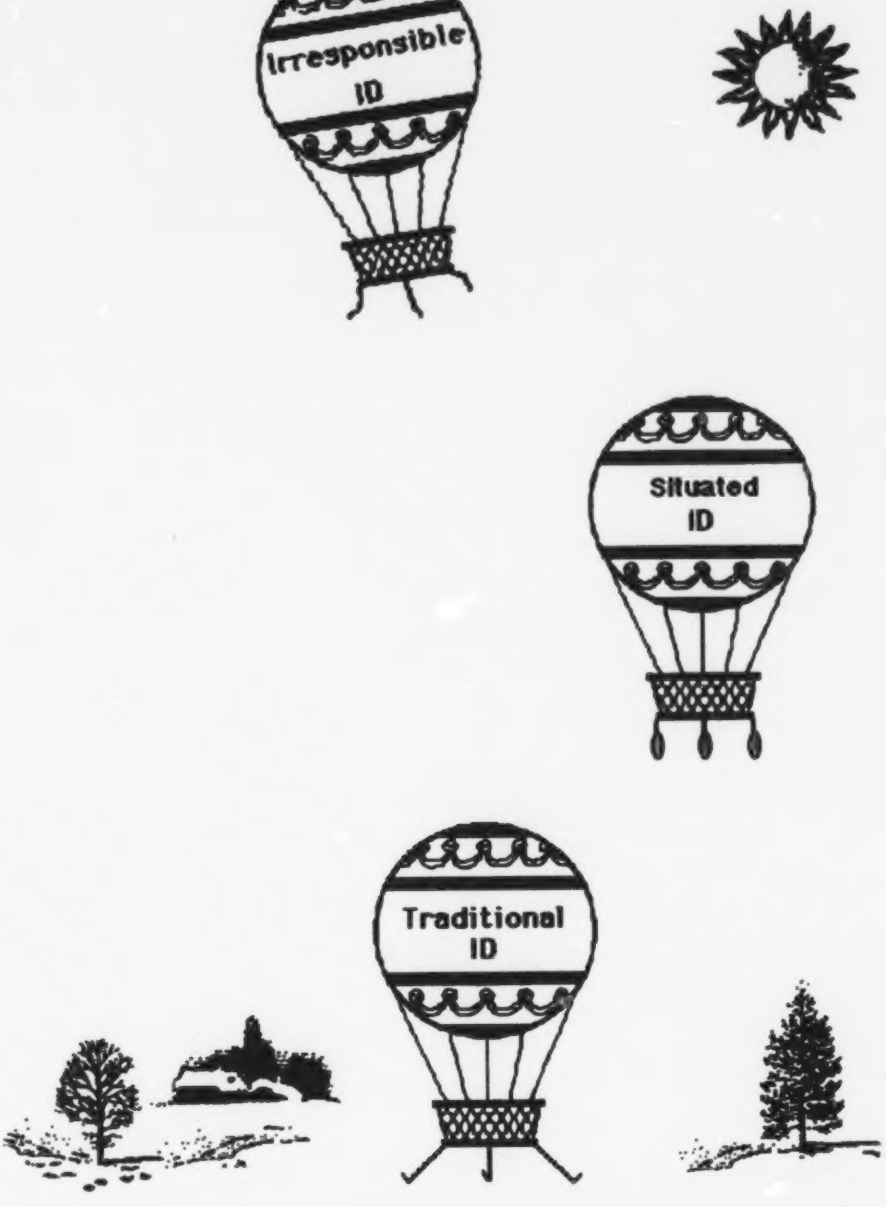

Figure 1. Hot air balloon analogy.

Figure 1 illustrates this tension by reference to a hot air balloon trying to reach upward, but being tethered down by a number of constraints—some real, some artificial. Ignore the constraints entirely and project costs rise into the stratosphere. The point is that we need a balanced set of safeguards and constraints that assure careful design and accountability but which are flexible enough to allow the project to safely "fly."

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WHO DOES THE DESIGN?

A key element in effective ID is the nature of the design team. Instead of a designer and subject expert working in relative isolation, situated ID suggests that all major constituencies be represented on the design team, including teachers and students. These end users—the "consumers" of the instructional "product"—should contribute directly to the project's design and development. Greenbaum & Kyng (1991) refer to this as *participatory design*, and Clancey (1993) recommends "we must involve students, teachers, administrators, future employers, and the community as participants in design..., working with students and teachers in their setting—not just calling them into the...lab to work with us" (pp. 9, 20).

An instructional designer might complain: "But we've always incorporated the end user in our ID models; this sounds like warmed-over formative evaluation." I would respond: "If formative evaluation got done a tenth as much as it gets talked about, ID practice would be in much better shape." In many ways, a constructivist or situated approach to ID takes old ideas and gives a new impetus to them. Consider the traditional roles of team members:

- *Subject matter expert (SME).* Provides the content and expertise.
- *Designer.* Figures out a way to extract (milk?) expertise from the SME and encode it into instructional materials. Selects instructional strategy appropriate to the content and the situation to effectively teach the content to the learner.
- *Teacher and student.* At formative evaluation stages, serve as subjects for tryout tests to maximize usability and learnability. At implementation stage, teachers and students take the instructional materials and carefully use them as directed. Something like a doctor's prescription.

Situated ID mixes up the roles much more. SMEs can help design learning experiences; designers manage projects, build teams, check for content accuracy, and serve as model learners and teachers. Teachers and students may help define or select content and design their own learning experiences. Poorly implemented, the redefinition and blurring of roles can lead to chaos and confusion; well implemented, a flexible team orientation can result in a synergy or a fusion of multiple perspectives that improves the design.

GUIDELINES FOR DOING SITUATED/CONSTRUCTIVIST ID

This section is composed of a laundry list of tips for viewing ID from a situated perspective, organized according to generic ID phases. Issues of implementation, discussed at the beginning of the paper, are not addressed in detail. Some of the tips are abstract and conceptual; others are simple and practical. Some depart radically from current practice; others reflect how most practitioners already view their jobs. Collectively, they provide a clearer picture of what it means to do situated ID.

GENERAL METHODOLOGY

- *Include end users (both teachers and students) as part of the design team.* Incorporate participatory design techniques, with design activity moving out of the "lab" and into the field.
- *Configure a design model appropriate to the task at hand.* Several constructivist models of instruction present six or seven key principles. Why not let a design team themselves select or develop the principles that best reflects their values? Each design team needs to configure a model—cutting and pasting from extant literature and practice—that is tailored to their community and the constraints of the project.

NEEDS ASSESSMENT

- *Consider solutions that are closer to the performance context* (job aids, just-in-time training, performance support systems, etc.). This is consistent with situated models of cognition and with the notion of distributed cognition (Perkins, 1993).
- *Resist the temptation to be driven by easily measured and manipulated content.* Many important learning outcomes cannot be easily measured.

- *Ask: Who makes the rules about what constitutes a need? Are there other perspectives to consider? What (and whose) needs are being neglected?* These questions arise out of the postmodern notion of the ideological base of all human activity.

GOAL/TASK ANALYSES

- *Use objectives as heuristics to guide design.* Don't always insist on operational performance descriptions which may constrain the learners' goals and achievement. Pushing goal statements to behavioral specifications can often be wasted work. The "intent" of instruction can be made clear by examining goal statements, learning activities, and assessment methods. Goals and objectives should be specific enough to serve as inputs to the design of assessments and instructional strategies.
- *Don't expect to "capture" the content in your goal- or task analysis* . Content on paper is not the expertise in a practitioner's head, hands, and feet. The best analysis always falls short of the mark. The only remedy is to design rich learning experiences where learners can pick up on their own the content missing between the gaps of analysis.
- *Allow for instruction and learning goals to emerge during instruction.* Just as content cannot be fully captured, learning goals cannot be fully pre-specified apart from the actual learning context. See Winn (1990) for a thorough discussion of this issue.
- *Consider multiple stages of expertise.* Expertise is usually thought of as having two levels: Expert or proficient performance and novice or initial performance. Of course, a two-level model is insufficient for accurate modeling of student growth over time. A series of qualitative models of expertise may be needed for modeling students' progression in learning critical tasks (White & Frederiksen, 1986). Be prepared to confront learners' naive, intuitive theories and to scaffold their learning.
- *Give priority to problem-solving, meaning-constructing learning goals.* Instead of rule-following, emphasize problem solving (which incorporates rule-following but is not limited to it). Instead of simple recall tasks, ask learners to make sense out of material and demonstrate their understanding of it.
- *Look for authentic, information-rich methods for representing content and assessing performance (e.g., audio, video).* High-resolution methods for representing content can be useful throughout the ID process. Whereas we usually associate audio and video representations only with *presentation* of material to students, the same representation tools may be useful for documenting expertise and assessing student understanding.
- *Define content in multiple ways. Use cases, stories, and patterns in addition to rules, principles, and procedures.* Rich cases, stories, and patterns of performance can be alternative metaphors for finding and representing content.
- *Appreciate the value-ladenness of all analysis.* Defining content is a political, ideological enterprise. Valuing one perspective means that other perspectives will be given less value. One approach is given prominence; another is neglected. Somebody wins, and somebody loses. Be sensitive to the value implications of your decisions.
- *Ask: Who makes the rules about what constitutes a legitimate learning goal? What learning goals are not being analyzed? What is the hidden agenda?* Twenty years ago, a designer using "understanding" in a learning objective would have been laughed out of the office. "Understanding" was fuzzy; it was forbidden. Are there other expressions of learning outcomes that remain taboo? Are there other dimensions of human performance that remain undervalued? Good postmodern ID would pursue answers to these questions and be unafraid of reexamining current practice.

INSTRUCTIONAL STRATEGY DEVELOPMENT

- *Distinguish between instructional goals and learners' goals; support learners in pursuing their own goals.* Ng and Bereiter (1991) distinguish between (1) task-completion goals or "hoop jumping," (2) instructional goals set by the system, and (3) personal knowledge-building goals set by the student. The three do not always converge. A student motivated by task-completion goals doesn't even consider learning, yet many students' behavior in schools is driven by performance requirements. Constructivist instruction would nourish and encourage pursuit of personal knowledge-building goals, while still supporting instructional goals. As Mark Twain put it: "I have never let my schooling interfere with my education."

- *Allow for multiple goals for different learners.* ID often includes the implicit assumption that instructional goals will be identical for all learners. This is sometimes necessary, but not always. Hypermedia learning environments almost by definition are designed to accommodate multiple learning goals. Even within traditional classrooms, technologies exist today for managing multiple learning goals (Collins, 1991).
- *Appreciate the interdependency of content and method.* Traditional design theory treats content and the method for teaching that content as orthogonally independent factors. Situated ID says you can't entirely separate the two. When you use a Socratic method, you are teaching something quite different than when you use worksheets and a posttest. Teaching concepts via a rule definition results in something different than teaching the concept via rich cases. Just as McLuhan discerned the confounding of "media" and "message," so designers must see how learning goals are not uniformly met by interchangeable instructional strategies (see Wilson, in press a).
- *Look for opportunities to give guided control to the learner, encouraging development of metacognitive knowledge.* Encourage growth in students' metacognitive knowledge, what we often call "learning how to learn." Don't assume that students know how to exercise effective learning control; instead, establish metacognitive skills as a learning goal for instruction to achieve.
- *Allow for the "teaching moment."* Situations occur within instruction where the student is primed and ready to learn a significant new insight. Good teachers create conditions where such moments occur regularly, then they seize the moment and teach the lesson. This kind of flexibility requires a level of spontaneity and responsiveness not usually talked about in ID circles.
- *Think in terms of designing learning environments rather than "selecting" instructional strategies.* Metaphors are important. Does the designer "select" a strategy or "cultivate" a climate conducive to learning? Wilson (in press b) argues for learning environments to complement our product, process, and systems metaphors for instruction. More often than not, teachers and designers create or adapt an instructional strategy rather than "selecting" one.
- *Think of instruction as providing tools that teachers and students can use for learning; make these tools user-friendly.* This frame of mind is virtually the opposite of "teacher-proofing" instructional materials to assure uniform adherence to designers' use expectations. Instead, teachers and students are encouraged to make creative and intelligent use of instructional tools and resources.
- *Appreciate the value-ladenness of instructional strategies.* Sitting through a school board meeting is enough to convince anyone of this. Instructional strategies grow out of our philosophies of the world and our value systems. Not only the content, but the strategy can be a threat to particular ideological positions or to learner motivation. Good designers will be sensitive to the "fit" between their designs and the situation.

MEDIA SELECTION

- *Consider media factors early in the design cycle.* Practical and cost constraints typically dictate that tentative media decisions will be made relatively early in the design process. Media then becomes one of the instructional factors that receives increasing attention through iterations of analysis.
- *Include media literacy and biases as a consideration in media decisions.* Different media send different "messages" to an audience, independently of the instructional content. Look for any "hidden curriculum" elements in different media choices. Avoid negative stereotypes and cultural biases. Consider the rhetorical goodness of fit between media choice and overall instructional purposes. Also, design messages that are sensitive to an audience's media sophistication and literacy, paying particular attention to humor, media conventions, and production values.

STUDENT ASSESSMENT

- *Incorporate assessment into the teaching product where possible.* Technologies are available for incorporating continuous, "dynamic assessment" into learning materials (Lajoie & Lesgold, 1992). Assessment can then be seamlessly integrated into meaningful learning experiences and not tacked on at the end (Frederiksen & Collins 1989).
- *Critique and discuss products grounded in authentic contexts, including portfolios, projects, compositions, and performances.* Use of work products can complement more direct, traditional measures of knowledge acquisition and understanding (Cates, 1992). Include different perspectives in the critiquing process.

- *Evaluate processes as well as products.* The cognitive apprenticeship model offers a number of strategies for reflecting on process: debriefings, abstracted replays, dramatizations, interviews, group discussions, knowledge telling, co-investigation, and post-mortems of problem-solving activities (Collins & Brown, 1987; McLellan, 1993; Gay & Mazur, 1993).
- *Use informal assessments within classrooms and learning environments.* Informal assessments refer primarily to teacher observations of eye contact, body language, facial expressions, and work performance. These observations can complement formal assessments as a basis for instructional adjustments.

At this point, we should consider the pros and cons associated with following a more situated model of design. Here is a list of possible advantages:

- more meaningful learning outcomes that are likely to be used in relevant contexts
- more meaningful participation of the learner in the learning process
- more independent problem-solving capability
- more flexibility in design activities
- more flexibility in instructional activities
- more acknowledgment of social and motivational factors in learning.

Here are some possible risks:

- more costly instruction
- greater need for instructional resources and information management
- less coverage of material
- less demonstration of specific skill mastery
- chaos and confusion if poorly implemented.

The point is: (1) we really don't know all the pros and cons of new approaches, because we've never fully tried them out, and (2) as any situationist would say, it depends on the situation, on how it's done. There are good ways to do situated ID and bad ways, just as one can point to excellent and poor examples of training developed with an objectivist philosophy. We will learn more about the real pros and cons of doing situated ID as more design models become available and as they become more widely used. Obviously, the details of situated approaches to instructional design have not yet been thoroughly worked out. At a time of such basic re-thinking about the nature of cognition, it is hard to be dogmatic about what teaching strategies comprise the "optimal" design in any subject matter. Perhaps the main lesson for now is that the discussion should be followed with a certain degree of skepticism, with an eye toward implications for professional practice. Our knowledge base in cognition and instructional design really is fragile, depending on a shifting foundation that will likely continue to change in the years to come.

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Title:

Interactivity In Computer-Based Aural Skills Instruction: A Research Study

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Comparing the effects of interactive audio in Computer-Based Instruction (CBI) versus non-interactive audio in CBI on the skills and attitudes of music students in identifying harmonic voicing has been divided into two sub-problems for the purposes of this study. The first sub-problem is to compare music students' skill in identifying harmonic voicing using interactive versus non-interactive audio. The second sub-problem is to compare music students' attitude toward CBI using interactive versus non-interactive audio. A two group pretest-posttest experiment was conducted in which forty-six participants volunteered to work with a computer program developed for this study; the experimental group used interactive audio and the control group used non-interactive audio; and, both groups completed an attitude measure. The test scores showed acceptable to high reliability. Analysis of the data revealed that the experimental group showed greater skill development than the control group in identifying harmonic voicing. Analysis of the attitudinal measurement revealed no difference between the groups.

The subject area of study is aural skills training in music. The musician in ensemble performance is typically surrounded by harmony. A good performance is partially dependent upon proper relationships among voices. Effective harmonic analysis provides the foundation for understanding the interrelationships between voice parts: identification of individual voices which make up the vertical harmonic structure requires abilities in listening and analysis. Although music and music education may initially appear to be quite self-contained without the need for technology, modern technology can be very valuable to both the modern musician and the music teacher. Using CBI for aural training in music implies the use of audio: it is not the purpose of this study to examine the use of audio in CBI but to examine the implications of allowing user-control of specific parameters of the audio. Hofstetter pioneered the research supporting CBI using the PLATO system with a program called GUIDO (Hofstetter, 1975, 1979). Taylor (1982) evaluated computerized melodic dictation using PLATO and a program called MEDICI. He recommended that MEDICI be used at the university level of study and suggested further developments for CBI in aural skills. Interactive audio in computer-based aural skills instruction has not been thoroughly documented: GUIDO allowed student control of individual voices (Arenson & Hofstetter, 1983) but the effectiveness of this interactivity was never evaluated. Woodrulff & Heeler (1990, 1991) and Ashley (1989) successfully used interactive audio with videodisk and CD-ROM technology to develop listening skills of music students. Aural skills need to be developed in order for musicians to experience music more completely. Given that involving the student in interactive dialog during analysis can help form better listeners and better musicians (Pogonowski, 1989) and that computer technology with multimedia has been successfully applied in music education (Ashley, 1989; Gillespie & Placek, 1991; Kuzmich, 1989; Woodrulff & Heeler, 1990, 1991), CBI in aural skills with multimedia presentation in an interactive environment may lead to increased student abilities in harmonic analysis. Interactivity in this context refers to audible samples of three part harmonies utilizing user control of individual voice volume.

Review of Related Literature

Identification of harmonic voicing is closely related to harmonic dictation and is one of many fundamental aural skills. Aural skills remain an important foundation for musicians. The term refers to skill in recognition or identification of various components of music. Some of these components are: intervals, melodies, chords, harmonies, rhythms, timbres, and dynamics. Listening for all these components at the same time is very complicated (Madsen & Geringer, 1990) and therefore either very sophisticated measurement is necessary, or individual components should be used for training and evaluation. Studies in aural skills, both with and without computer aid, have looked at many of these individual components.

Computer-Based Instruction

A wealth of literature exists which shows the merits of using CBI in education. CBI can offer individualized instruction. Bloom (1984) describes methods of instruction and concludes that individualized instruction, specifically one-to-one tutoring, results in the greatest improvement in achievement. Kulik, Kulik and Cohen (1980) conclusively show that the use of CBI results in increased achievement. By the mid 1970's main-frame computers were supporting aural skills training programs (Hofstetter, 1975), and research was indicating positive results of CBI in music. The capability of the computer (mainframe and micro) to generate and play music provides a means for aural skills training on an individual basis without the costs and difficulties of human tutoring or individualized classroom instruction.

Aural Skills and CBI

One program for aural skills training is the source for some of the pioneering research in this area. GUIDO is a system which was developed beginning in 1974 for operation on a PLATO main-frame (Hofstetter, 1975, 1981; Arenson & Hofstetter, 1983). A series of four studies all supported the use of CBI for aural skills training (Hofstetter, 1978, 1979, 1980, 1981) and recommended further study in the area.

In addition to the studies by Hofstetter, other research supports the use of CBI in aural skills. Canelos, Murphy, Blombach and Heck (1980) evaluated mastery learning, linear instruction and self-practice as methods for teaching interval identification. Their results show that mastery learning and linear instruction (both CBI) are superior to the traditional method in terms of achievement. Other studies compared CBI competency based learning of aural skills to traditional methods (Arenson, 1982; Greenfield & Codding, 1985) and found significant differences in achievement in favour of CBI. Another study on CBI in aural skills was done using MEDICI, a system developed in 1980 for operation on a PLATO main-frame (Newcomb, Weage and Spencer, 1981; Taylor, 1982). Taylor found no difference in achievement between CBI and traditional instruction in melodic dictation, however CBI proved to be more efficient and was recommended for further use. A more recent study comparing CBI and traditional instruction in music education was done by Bailey (1989) and similar results were found: CBI in music results in higher achievement.

Interactive Multimedia

Woodrulff and Heeler (1990) compared the use of CBI and interactive videodisk versus CBI and no videodisk. In the study, video capabilities were not used: at the time of the study videodisk technology was simply more accessible than CD-ROM technology, and therefore was used as an audio source. The study showed increased achievement as a result of interactive CBI. Where previous studies usually compared CBI with traditional instruction, Woodrulff and Heeler compared two groups which both use CBI, differing only in terms of interactivity. Ashley (1989) used CD-ROM technology for developing listening skills in music students. The study reported that interactive CD-ROM was effective in honing listening skills with respect to rhythm, harmony, melody, form and timbre. These studies (Ashley, 1989; Woodrulff & Heeler, 1990) support further research into interactive applications in computer-based music instruction. With regard to interactivity, Taylor (1988) commented that "students will become more involved when they can interact with their learning environment in interesting and different ways, and they will also have the opportunity to be creative in their personal approaches to learning" (p. 54).

Attitudes Towards CBI and Aural Skills

Many studies, in addition to evaluation of achievement, also include attitudinal surveys. The majority of studies dealing with CBI and aural skills report that students have positive attitudes toward CBI in music: students show increased interest, enthusiasm and motivation in music studies (Canelos, Murphy, Blombach & Heck, 1980; Clarkson & Pegley, 1991; Gross & Griffin, 1982; Hoffman, 1991; Hofstetter, 1979; Upitis, 1982; Weintraub, 1991). One study reported that no change in attitude occurred during the experiment (Humphries, 1980), however, the study does not indicate if the attitudes toward CBI in aural skills were positive or negative.

A notable exception identifies a majority of students who indicate that they felt CBI lessons in aural skills were too time consuming (Greenfield and Codding, 1985). These findings are supported by Pembrook (1986) who found that the majority of students who had used MEDICI reported a negative experience. Positive comments were made regarding the difficulty level of content, individualization, schedule flexibility, immediate grading and positive feedback, however the majority of students complained about the time commitment needed for CBI.

The majority of attitudinal surveys report general positive attitude toward CBI although some exceptions exist. Generally, student attitude seems to favour CBI in music aural skills.

Summary

Since much research points to the conclusion that CBI is effective and efficient, subsequent research has not bothered with the comparison of CBI and traditional instruction but instead has concentrated on variables within the CBI environment. CBI in aural skills has been effective both in terms of achievement and student attitude. Continuation of CBI applications in music is warranted and less developed areas such as harmonic voice identification, which have not been well documented, should be studied. This recommendation combined with the support for interactive CBI prepare sufficient groundwork for this study. Newcomb (1988) summarizes and supports CBI in music:

How are we doing in computer-based music instruction? We have made a beginning. The vineyard is large, the workers are few, and budgets are small. The work is fascinating. Public interest is growing, and the long-term outlook is partly sunny. (p.49)

The Current Study

Statement of the Problem

To compare the effects of interactive audio in CBI versus non-interactive audio in CBI on the skills and attitudes of music students in identifying harmonic voicing.

Two sub-problems were used:

1) to compare music students' skill development in identifying harmonic voicing using interactive audio in CBI with those using non-interactive audio in CBI; and,

2) to compare music students' attitudes toward CBI in aural skills and interactive audio with those toward CBI in aural skills and non-interactive audio.

Method

The participants were a volunteer sample from an accessible population of university music students studying aural skills. Approximately ninety-five students were eligible for the study and forty-six volunteered to participate. A non-commercial computer program developed specifically for the experiment was used to deliver the lesson and gather data. All participants completed the pretest, experimental treatment, posttest and attitude survey in one session, lasting approximately one hour, on the same equipment. The study included musical content consisting of differentiation of major, minor and diminished triads.

The experiment was structured as a pretest-posttest control group design : similar in design to Hofstetter (1979) and Woodrulff & Heeler (1990). Each participant was randomly assigned to either the control group or the treatment group. Although both groups used the same program, the experimental group (interactive audio) had control over individual voice volumes in the audio component; whereas, the control group used computer-controlled voice volumes in the audio component. All participants were able to hear the audible samples multiple times upon request. As the participants progressed through the sequence of the program, relevant data were recorded in an external file.

Instrumentation

A computer program in four parts developed with Authorware Professional © version 1.7 for Macintosh was used to deliver the lesson and collect data. This platform was chosen because of the familiarity the aural skills students had with Macintosh computers from use in the aural skills course. The program was developed carefully with input from both instructional designers and content experts. Two customized features were used with Authorware Professional: an external command (XFCN) was built to play the triads (SndCmd XFCN uses control parameters to generate wave patterns at defined frequencies using the internal tone-generators in the Macintosh. using System 7) and a modified version of the RunAPM file was used to deliver the program (the "return" icon used in Run APM version 1.7A.1 was modified to match the arrow icons used in the program).

Results for the First Sub-problem

To determine skill development in identifying harmonic voicing, individual scores on the aural harmony pretest and posttest were tabulated. The numbers are raw scores out of twenty, each set corresponding to one individual from either the experimental or control group. Summaries of these scores can be found in Table 1 and Figure 1.

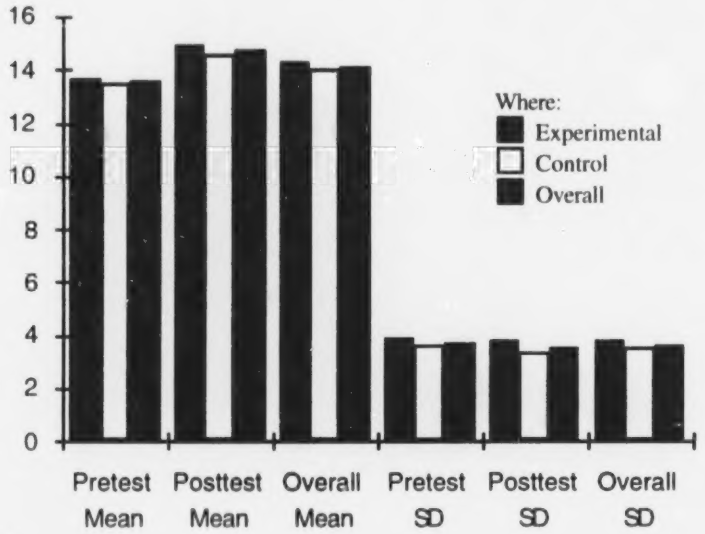
Table 1.

Test scores of identification of harmonic voicing.

	n	Pretest Mean	Posttest Mean	Overall Mean	Pretest SD	Posttest SD	Overall SD
Experimental	22	13.6	14.9	14.3	3.9	3.8	3.8
Control	24	13.5	14.5	14.0	3.6	3.3	3.5
All Subjects	46	13.5	14.7	14.1	3.7	3.5	3.6

Figure 1.

Test scores of identification of harmonic voicing



Reliability coefficient alpha was 0.72 for the twenty item pretest indicating that the test was internally consistent and reliable. The posttest was structured identical to the pretest, however the audible samples were different and the correct responses therefore were also different. Coefficient alpha for the twenty item posttest was 0.72. The reliability coefficients are the same, however differences exist between the tests allowing greater confidence in comparing the two tests.

An ANOVA model was used in a 2 (group) X 2 (Time: pretest vs. posttest) analysis of variance with repeated measures on the last variable (see Table 2). Analysis revealed no difference between the experimental group and the control group overall: F(1,44) = .07, p = .79. Analysis revealed a significant difference overall within the groups between the pretest and the posttest: F(1,44) = 15.91, p < .05. Analysis revealed no interactive effect between the groups: F(1,44) = .10, p = .75 (the interactive effect is shown in figure 2).

Table 2.

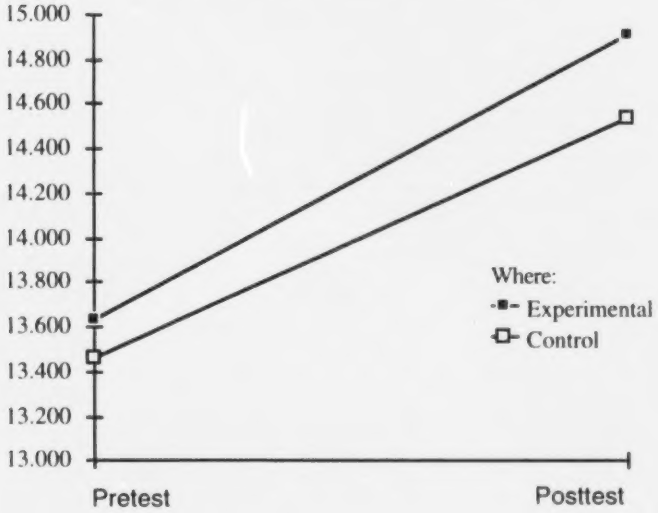
ANOVA of group X time (pretest vs. posttest)

Source	df	MS	F
Between Subjects			
Group	1	1.71	.07
Error	44	24.61	
Within Subjects			
Time	1	31.86	15.91*
Group X Time	1	.21	.10
Error	44	2.00	

* $p < .05$

Figure 2.

Comparison of score differences in identification of harmonic voicing



An apriori hypothesis tested using a Scheffé contrast showed the experimental group differed between the pretest and the posttest: $F(1,44) = 2.98$, $p < .05$; the control group effect across the pretest and posttest was negligible: $F(1,44) = 2.65$, $p = .11$. Winer (1962, p. 85) observed "The apriori type is always justified whether or not the overall F is significant".

Conclusion regarding the First Sub-problem.

The between-group-effect was negligible ($p>.05$), indicating that no differences existed between the control group and the experimental group overall (collapsed across the tests), however the significant within-group-effect ($p\leq.05$) between the pretest and the posttest showed that there is a difference in the overall achievement scores between the two tests (collapsed across the groups). Where the ANOVA model uses the overall scores for analysis, the Scheffé contrast does not collapse across the groups and therefore can attribute the difference noted in the ANOVA to a specific source: in this case, a difference when contrasting the pretest and posttest scores of each group The contrast showed a difference between the pretest and posttest scores of the experimental group but not the control group. Relative to the first sub-problem, interactive audio resulted in better skill development in identifying harmonic voicing than non-interactive audio.

.. Results for the Second Sub-problem

To determine student attitude toward CBI in music, a post-treatment attitudinal measurement was taken using a Likert-type survey. The category results are raw scores in five categories, each set corresponding to one individual from either the experimental or control group. Category A deals with instructional strategy scored out of seventy. Category B deals with the personalization of CBI scored out of thirty. Category C deals with individual reaction scored out of sixty five. Category D deals with interest in the subject matter scored out of twenty. Category E deals with the technical operation of the equipment scored out of twenty-five. The total is the sum of all categories and represents an overall positive attitude toward CBI in aural skills scored out of two-hundred-ten. Table 3 and figure 3 summarize the data for the second sub-problem.

Table 3.

Positive attitudes toward CBI in aural skills

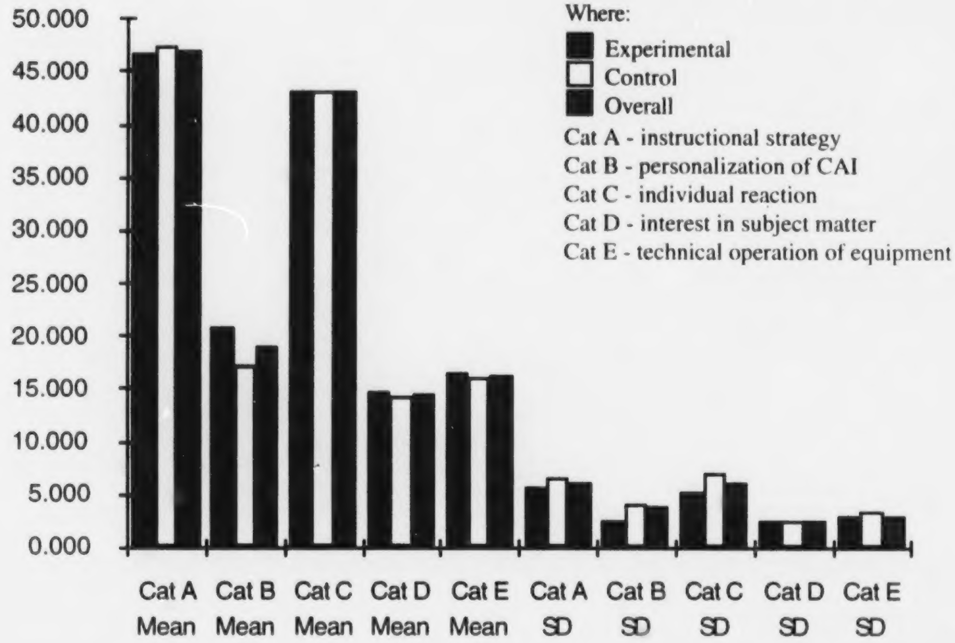
Mean Values:	n	Cat A	Cat B	Cat C	Cat D	Cat E	Total
Experimental	22	46.6	20.7	43.0	14.6	16.4	141.4
Control	24	47.3	17.1	43.0	14.2	16.0	137.7
All Subjects	46	47.0	18.8	43.0	14.4	16.2	139.4

SD Values:	n	Cat A	Cat B	Cat C	Cat D	Cat E	Total
Experimental	22	5.6	2.5	5.3	2.4	2.8	14.6
Control	24	6.5	4.0	7.0	2.5	3.3	19.4
All Subjects	46	6.0	3.8	6.1	2.5	3.0	17.2

where: Cat.A-instructional strategy, Cat.B-personalization of CAI, Cat.C-individual reaction, Cat.D-interest in subject matter, Cat.E-technical operation of equipment

Figure 3

Positive attitudes toward CBI in aural skills



Reliability coefficient alpha for the forty-two item attitude survey was 0.92. In addition, Cronbach's alpha, which accounts for relative weights between the five sub-categories, was 0.81. In each case, alpha is higher than the accepted minimum value of 0.65 when working with a group of scores (Frisbie, 1988). These figures indicate high internal consistency and reliability in the survey. The data indicated a small difference in opinion toward CBI in category B; a very small difference in categories A, D and E; and category C showed no difference. An ANOVA model was used to determine if any of these observed effects were significant. In order to implement the ANOVA, the raw scores were first translated into z-scores (see Table 4).

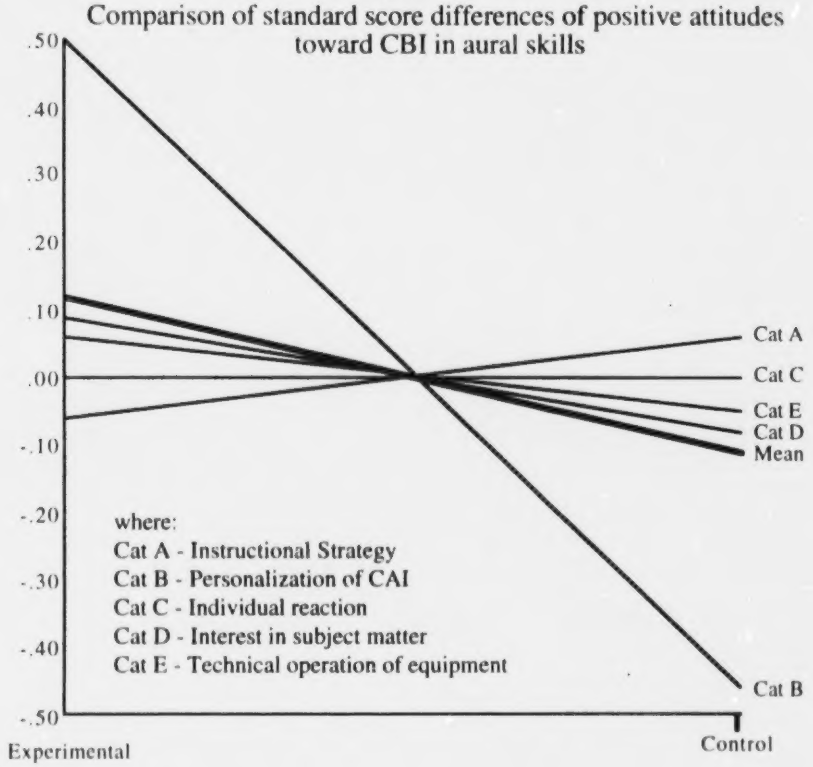
Table 4.

Standardized scores of positive attitudes toward CBI in aural skills

z-scores:	n	Cat A	Cat B	Cat C	Cat D	Cat E	Mean
Experimenta	22	-.06	.50	.00	.09	.06	.12
Control	24	.06	-.46	-.00	-.08	-.05	-.11
Mean	46	.00	.00	.00	.00	.00	.00

where: Cat A-instructional strategy, Cat B-personalization of CAI, Cat C-individual reaction, Cat D-interest in subject matter, Cat E-technical operation of equipment

Figure 4.


Comparison of standard score differences of positive attitudes toward CBI in aural skills

The data conversion to z-scores results in a non-legitimate main effect within group (the mean in each category is zero). For the purposes of this study, the within group effect was not important, however, the between group effect was important. The analysis revealed no difference between the experimental group and the control group ($p > .05$). The analysis showed a significant interactive effect: $F(4,176) = 4.83$, $p < .05$.

An analysis of contrasts was performed (Scheffé) in order to attempt to identify the source of the interaction. The analysis showed no significant contrasts between any of the categories ($p > .05$).

Conclusion regarding the Second Sub-problem.

The between group effect in the second sub-problem was negligible, indicating no overall difference between the experimental group and the control group (see the mean slope in figure 3). A significant interaction was noted; however, given that the subsequent contrasts revealed no differences within individual groups, the interaction was considered marginal. The z-scores for categories A, C, D and E all approached zero, however the z-scores for category B were anomalous. Even though the contrasts showed no difference, the anomalous scores in category B warrant discussion (see figure 4).

The z-scores in category B represent the participant's reaction to the personalization of the instructional material. It is interesting to note that the group using the interactive audio responded more positively toward the personalization of the program than did the group using non-interactive audio. This may indicate that interactivity results in a perceived increase in user-friendliness or personalization in CBI. This speculation is based only the anomalous slope of category B, it should be noted that statistically this score falls within the probability limits of non-significance.

Summary of Results

The two sub-problems were handled independently using statistical analysis to derive greater meaning from the raw data. The analysis was done using a probability level of .05 to determine significance. Based on test results which were reliable, the data for the first sub-problem showed significant effects, indicating that CBI with interactive audio resulted in better skill development at identifying harmonic voicing than did CBI with non-interactive audio. Based on test results which had high reliability, the data for the second sub-problem showed no significant effects, indicating that no differences regarding attitude toward CBI in aural skills were present between the two groups.

Conclusions and Recommendations

Conclusions

The results of this study are limited to CBI in identification of harmonic voicing in aural skills and may only be generalized to similar populations of music and music education students in Canada. The attitude of the experimental group did not differ significantly from the attitude of the control group; however, all participants volunteered for the study without coercion and the sample, therefore, may have had a predisposed positive opinion about computers in music education. This could have been a factor in their decision to volunteer, and also a factor which may have affected the attitude survey - possibly resulting in a general positive attitude towards CBI in aural skills. Confidence in any generalizations regarding attitude in this study is limited.

With regard to achievement, the skill development in the experimental group was greater than that of the control group: this supports the use of CBI with interactivity in aural skills. Confidence in the measurement of achievement is supported knowing that the sample was homogenous with regard to attitude towards CBI in aural skills: discrepant attitudes between the groups can be ruled out as a possible source for differing achievement between the groups. The measurement results show acceptable to high reliability coefficients.

Some conditions in the study may help to explain why no significant differences were found between the attitudes of the experimental and control groups. With the exception of interactive control of harmonic voices (the basis for the study), the CBI modules were identical. The participants were involved in a style of aural skills training which was relatively new and unused in regular aural skills classes and as a result the overall novelty of this instruction may have overshadowed any attitudinal differences attributable to the interactivity and may have provoked positive attitudes in all users. Previous studies indicate that students show more positive attitudes toward CBI in aural skills than toward traditional classroom aural skills training. It is likely that when both groups used CBI in aural skills, the differences in interactivity while effecting achievement may not have effected attitude.

Each participant was active in the study for approximately one hour, in which time, the pretest, treatment, posttest and attitude modules were completed. Participants may have required a longer exposure to CBI in order to offer accurate statements of attitude.

Similarly, several factors warrant discussion which may help to explain other reasons for the differences found in achievement. One hour may not have allowed enough time to accurately measure learning in a subject area which the participants have spent years studying. Claims regarding effectiveness of interactivity may require longer exposure to treatment in order to be valid. Although this study accurately shows differences in achievement between groups using interactive versus non-interactive audio, greater validity may be gained by applying the treatment over periods of time which are proportional to the time students spend learning aural skills in regular classes at university. Pretest contamination may have been a factor which resulted in increased scores on the posttest. The analysis showed no overall difference between the groups but did show a difference within the groups, possibly attributable to exposure to the pretest, however, because the participants were randomly assigned to either the control group or the experimental group and both groups took the same pretest, it is assumed that any pretest contamination would be equal for both groups, leaving any differences attributable to the treatment differences between the groups. The results of the contrast analysis support this by attributing the differences to the treatment, specifically to the interactivity built into the program used by the experimental group.

These results support the findings by Woodrulff and Heeler (1990) which indicate that interactive audio results in higher achievement by music appreciation students; and, also support Ashley's conclusions (1989) that interactive audio is effective in increasing the listening skills of music students. Support for CBI in aural skills and continued research in the area is consistent with many other studies (Arenson, 1982; Bailey, 1989; Canelos, Murphy, Blombach & Heck, 1980; Dalby, 1989; Greenfield & Codding, 1985; Hofstetter, 1978, 1979, 1980, 1981). Technology is advancing at an ever-increasing rate and the tools which become available to the aural skills student may advance to the point where comparisons with older technology are no longer valid: this only strengthens the need for ongoing research in the area.

Recommendations

Two limiting factors in this study could be eliminated in future studies. The sample size of forty-six participants is small: results using larger samples might be generalized to larger, more diverse populations. Also, the treatment time in this study was short: each student spent approximately one hour at the computer. The close proximity in time between the pretest and the posttest may have affected the test results. A study which is structured over a longer period (such as a semester) would likely allow greater confidence in the results.

This study used synthesized sounds from tone generators within the Macintosh computer. These sounds are accurate with regard to pitch and also include specific overtones which create a sound more similar to a natural sound than a sine wave; however, truly natural sounds can only be achieved through sampling technology, or very sophisticated synthesis. A study using CBI in aural skills could be designed to determine the effect of natural (sampled) sounds versus synthesized sounds on student achievement and attitude. A similar study could determine if music students respond better in aural skills to the natural sound of their major instrument than to other instruments. For example, can a trumpet major identify intervals played on a trumpet better than intervals played on a piano?

CBI has great potential for accommodating further research in aural skills with new advancements in hardware, software, MIDI and sampling technologies.

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Appendix

Description of the Program

The four parts of the computer program are described below. Although the modules are each self-contained executable programs, they are transparently linked together in one seamless presentation.

The first part of the program is a pretest of abilities in aural skills (see Appendix B for a hard copy of the measurement items). Using triad samples prepared for audible computer delivery, the user identifies the quality of each triad as major, minor or diminished. To facilitate a two-group experimental design, there are two versions of this module: Module-One which links to Module-Two (using non-interactive audio) and Module-One-i which links to Module-Two-i (using interactive audio)
.

The second part of the program is a lesson in identification of triad quality (major, minor and diminished). Both versions of this module link to Module-Three.

The third part of the program is a posttest of abilities in aural skill, similar to the pretest in construction and content (see Appendix B for a hard copy of the measurement items). Although the questions in the posttest are identical in structure to the questions in the pretest, the posttest uses different audible samples. This module links to Module-Four.

Finally, the fourth part is a Likert-type survey of opinion toward CBI in aural skills (see Appendix B for a hard copy of the measurement items). The attitude survey is based on an instrument to measure opinion toward CBI from M. Szabo (personal communication, March 24, 1992). The instrument categorizes student responses into five sub-areas and a total. Each score in the sub-areas represents the relative positive attitude the student has toward CBI in aural skills.

The modules write all participant data to unique external files (see Appendix C for a file listing of the raw data totals gathered in this study). A file of all responses and calculated totals called "MassData" is created in the same location as the RunAPM file which is used to run the modules. The record layout of the file is shown below.

MassData record layout

Column 1 - group ID(1 or 2)
Column 2-21 - pretest answers (1, 2, 3, or 4)
Column 22-41 - posttest answers (1, 2, 3, or 4)
Column 42-83 - attitude responses (1, 2, 3, 4, or 5)

Following column 83 is a TAB delimited series of numbers:

Pretest total out of 20
Listen again number of times the user asked to re-hear a music sample
Volume control number of times the user adjusted the volumes of voices
Posttest total out of 20
Attitude category A total out of 70
Attitude category B total out of 30
Attitude category C total out of 65
Attitude category D total out of 20
Attitude category E total out of 25
Attitude total total out of 210

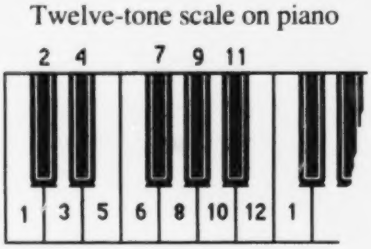
In addition a file called "Comment File" is created in the same location and contains any user comments which were anonymously logged during the session.

The program was validated by content experts in aural skills. The supervisor of aural skills in the music department provided content information during the construction of the program, made revisions and subsequently approved the program following completion. In addition, a music education faculty member made revisions to the program during development and subsequently offered approval. The program was also validated by an instructional design expert who made revisions and provided subsequent approval.

Music Terminology

A brief explanation of the musical terminology and symbols used is included here in order to add clarification to any subsequent musical references. During the computer session the students were asked to identify the chord quality of audible triads. Only major, minor and diminished chord qualities were used. It is important to recognize that musical theory is not the focus of the study, but rather the aural discrimination of differences in the chord qualities. Therefore, for the purposes of this document, the theory is explained in a manner suitable for understanding the aural significance of the task and not in a manner typically found in standard musical references.

A triad is a combination of three notes, typically spaced in intervals of thirds, which form a chord. There are two types of thirds: major and minor, where a major third is an interval of four semitones and a minor third is an interval of three semitones. The entire harmonic structure of music in the western world is based on a scale of twelve semitones where a semitone is the distance (in frequency) between notes. The figure below shows the repeating scale of semitones on the familiar piano keyboard.



A minor third would be an interval from note 1 to note 4 (a difference of three semitones), and a major third would be an interval from note 1 to note 5 (a difference of four semitones). Similarly, another minor third would be an interval from note 5 to note 8, and a major third from note 5 to note 9, and so on. Each interval is relative to the lower note.

A major triad is formed from a major third and a minor third. For example, a major triad could be formed from note 1 and note 5 (major third) and note 8 (a minor third from note 5).

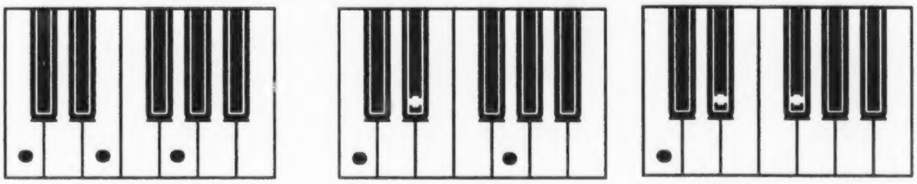
A minor triad is formed from a minor third and a major third. For example, a minor triad could be formed from note 1 and note 4 (minor third) and note 8 (a major third from note 4).

A diminished triad is formed from two minor thirds. For example, a diminished triad could be formed from note 1 and note 4 (minor third) and note 7 (a minor third from note 4).

Similarly, triads can be formed from any starting note as long as the intervals remain relative. For example, a major triad could be formed starting on note 3 and would consist of note 3, note 7, and note 10. A minor triad could also be formed starting on note 3 and would consist of note 3, note 6 and note 10. A diminished triad could be formed starting on note 3 and would consist of note 3, note 6 and note 9.

The students are required to differentiate aurally between these three types of qualities of triads. The differences are visually summarized in the figures below.

Major, minor and diminished triads on piano



Major

Minor

Diminished

Title:

The Effects of Elaboration on Self-Learning Procedures From Text

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Abstract

This study investigated the effects of augmenting and deleting elaborations in an existing self-instructional text for a micro-computer database application. A total of 60 undergraduate students were randomly assigned to the original, elaborated or unelaborated text versions. Students completed six tasks using one of the three instructional texts and then completed a six-item attitude survey. The absence of a significant difference in the task performance under the three text versions by a repeated measures ANOVA suggests that not all people require elaborations to develop a good understanding of procedural learning.

The Effects of Elaboration on Self-Learning Procedures From Text

Reading from text is one way in which people acquire knowledge or skills. An effective instructional text makes learners become active participants in the learning process rather than passive absorbers of information. In an age of independent, self-directed study, learning from texts is a common strategy, particularly in the computer industry. With the spread of personal computer systems, the issue of how to design effective self-instructional texts that facilitate the acquisition of knowledge and skills has become a very important one.

It is not uncommon to hear students complain about technical textbooks such as computer manuals. Obviously, if an instructional text designed for self-directed learning is too difficult to read or has confusing terminology, learners will become frustrated, and the negative experience would lower their motivation for learning. Pepper (1981) reported that students were looking for easy-to-read texts supported by many examples. Unfortunately, many computer textbooks and manuals don't use examples.

Documentation

Duin (1990) argued that computer documentation should center on the learner's goals, instead of on the system or on the concepts that are being taught. The learner's primary goal of reading computer manuals is to learn how to use the computer programs (skill learning), not only to know what the programs are (fact learning). In cognitive science literature, a similar distinction between fact learning and skill learning has been considered under the label of declarative versus procedural learning. Since learning to use a computer is a kind of procedural (skill) learning, learners want to extract information for immediate action rather than absorb knowledge for future recall.

Developers of computer documentation should also consider the cost of ineffective instructional texts. When instruction is inefficient, the costs incurred by both learners and business are extremely high (Carroll, 1990). Thus, the importance of designing an effective instructional text that facilitates procedural learning cannot be overemphasized.

Text-Based Elaboration

One variable that may increase the effectiveness of learning (particularly self-directed learning) from text is *elaboration*. According to Gagne "Elaboration is the process of adding related knowledge to the information being learned. The addition can be a logical inference, a continuation, an example, a detail, or anything else that serves to connect information" (Gagne, 1985, p.83). A common goal of elaboration is to attempt to make learning more meaningful by forming a relationship between the new, unfamiliar material and the older, already learned information. There has been ample research that indicates elaborations could help subjects learn and remember the main ideas of a text, because elaborations provide multiple retrieval routes to the essential information by creating more connections to the learner's prior knowledge (Reder, Charney, & Morgan, 1986). Elaborations also provide extra, useful information for constructing an answer (Reder, 1982). That is, elaborations can lead to better memory by increasing the redundancy of interconnections among the to-be-remembered information, and by imposing an organization on the information that can be used to guide the retrieval process.

Levin (1988), in his research review of elaborated-based learning strategies, indicated that elaboration can facilitate one's memory in learning because people's memory for nonmeaningful or arbitrary stimulus materials can be substantially improved through the addition of relevant connections or "mediators" (p.191). Over the last quarter of a century, there has been a great deal of evidence that shows elaboration-based strategies to facilitate students' performances in a variety of school-learning content areas and tasks. These range from memory for simple factual material to the processing of complex prose passages (see Levin, 1988, for a review). In addition, elaborations are beneficial for individuals with diverse characteristics and at all levels of ability, including wide variations in their age, ethnicity, intelligence, academic achievement, and specific abilities and aptitudes.

Reder and colleagues (1984, 1986) studied the informational content of manuals and the role of text-based elaborations. They defined text-based elaborations as "any information that supports, clarifies, or further specifies the main point of a text, including examples, details, analogies, restatements, and deductions" (Reder, Charney, & Morgan, 1986, p.64). Results from a large body of research consistently show that text-based elaboration facilitates learning in the acquisition and recall of declarative knowledge. In certain cases, such as for children with mental retardation, the more elaboration, the better (Levin, 1988). The reason is elaborations that relate to more than one part of the new knowledge are more effective in enhancing retrieval than are elaborations that relate to only one part of the new information. However, elaborations do not benefit all performance outcomes. For example, Mayer (1980) pointed out that the research indicates that elaboration in the form of artificially constructed verbal learning materials increased learner efficiency and recall.

By contrast, elaborations can also interfere with recall. There is ample evidence for the existence of retrieval interference both on recall and on response times to verification (Reder, Charney, & Morgan, 1986). Although elaborations help people remember relational information as well as specific information about the key concepts involved in the relationship, the results of Stein et al. (1984) showed that elaborations that enhance both relational and item-specific information do not require the activation of associatively related concepts that learners have previously acquired.

Learner-Generated vs Author-Provided Elaboration

The definition by Reder, Charney, & Morgan in 1986 includes two sources of elaborations: (1) those generated by learners while reading, and (2) those contained within the text provided by the author. Ideally, given a reading text, students would elaborate on new information by thinking of related ideas, examples, images, or logical inferences as they read. Thus, learner-generated elaborations are likely to be more relevant to his or her prior knowledge and purpose for reading the text. On the other hand, author-provided elaborations, such as examples, details, or embellishments, may be more accurate than those generated by the learner because the author is more knowledgeable and more familiar with the topic.

Elaborations either generated by the learner or provided by the author have their merits and drawbacks. For example, learner-generated elaborations have been found in several research studies to facilitate memory and retention. By elaborating on the presented material with their relevant prior knowledge, the subjects in these studies reviewed by Reder, Charney, and Morgan in 1986 show better retention of the material and better understanding of it. However, Reder et al.(1986) also indicated that not all author-provided elaborations supply similar benefits on retention of the central ideas in all learning situations, although they reported that both sources of elaborations do facilitate skill performance. Moreover, Levin reviewed several studies and suggested that with inefficient learners, it is better for an instructor to provide elaborations than to have the students generate them on their own (Levin, 1988). Carroll (1984) also argued that learner-generated elaboration such as "thinking," according to their prior knowledge, can often lead to mistakes while they are acquiring knowledge and skill in the computer domain. Therefore, in some situations learner-generated elaborations may be most effective, while in others author-provided elaborations may be best.

A number of factors contribute to which type of elaboration is most appropriate for a given situation. These include individual differences such as prior knowledge, age, ability, and the learner's own performance objective. Although Weinstein (1982) provided evidence that students can be trained to use elaboration to enhance learning, it remains to be determined whether generalized skills can be taught that would enable students to generate their own elaborators for a variety of procedural learning tasks.

Different Forms of Elaborations

Considerable research has been done in the area of author-provided elaborations to examine the effects of different forms of elaborations including examples, details, and embellishments on fact as well as on skill learning. In fact, not all research on author-provided elaborations has found to impair both kinds of learning. Generally speaking, the research suggests that author-provided elaborations may facilitate memory performance if they are constructed in view of the specific processes operating during testing. For example, an embellishing detail is expected to facilitate access to a super ordinate major idea during free recall while it is accessible itself and possesses sufficiently strong relations to the relevant major idea (van Dam & Brinkerink-Carlier, 1989). Some findings regarding the use of author-provided elaborations have shown the addition of embellishing details may facilitate future access to the embellished main ideas of a text during learning. For example, Bradshaw and Anderson (1982) found that recall performance for a central fact was better when it was supported by elaborated condition than when it was studied along with unelaborated condition. In addition, recall increases as the number of related details increases and the number of unrelated details decreases (Mohr, Glover, & Ronning, 1984). The results of van Dam & Brinkerink-Carlier's study (1989) indicated that embellishing information supplied in one paragraph may actually increase the accessibility of another paragraph if elaborations allow the plot-irrelevant information to be related to the story. However, Reder (1982) concluded that author-provided elaborations appear to help retention of the main ideas of a text only when subjects are allowed to reconstruct those main ideas during the retention test. Mandl et al. (1984) also argued that elaborated texts facilitated recall and comprehension only when the subjects were very familiar with the topic; otherwise, elaborated texts performed worse than unelaborated ones.

These findings are contrary to those of Reder and J. R. Anderson (1980, 1982), who examined the function of details and the effects of embellishment on memory for the main points of a text. They found, surprisingly, that subjects performed better after studying an abridged or summarized version of the original text than after studying a full, elaborated text. The advantages for summaries were maintained at retention intervals (from 20 minutes to 12 months) as well as in reaction times (subjects answered faster); were superior both for questions directly taken from the text and for inferences that required the subjects to combine facts that had been studied; and yielded better transfer, too. The advantages for summaries were found under a variety of study conditions including a non laboratory setting (Reder, 1982). Performance was superior even on new material when related material had previously been studied in summary form. Two possible causes concluded by Reder and J. R. Anderson (1982) are that (1) reading summaries allows the subject to reread the main points at spaced intervals, and (2) the presence of details distracts the subject's attention away from the critical ideas that should be attended to. In other words, details hurt retention of central ideas within a text when the study time is fixed, although they do increase interest and credibility. Moreover, Reder et al. (1986) found that when people already know what tasks they must perform, they benefit very little from seeing examples and other elaborations in the text.

Despite the assertion that author-provided elaborations may impede fact learning with a fixed study time, Reder, Charney and Morgan (1986) argued that author-provided elaborations may facilitate the domain of skill acquisition. Elaborations in computer documentation, according to Duin (1990), may expand on what the basic concepts are, when these concepts are relevant, and how users apply these to their immediate goals. In fact, elaborations seem most important for subjects learning to select and execute procedures correctly. To facilitate skill-performance, Reder et al. (1986) demonstrated author-provided elaborations for a personal computer that provided the learner with explanations and concrete illustrations of how the skill is performed. They found that these elaborations helped learners solve problems more quickly than minimal manuals without such elaborations. They also reported that only syntactic elaborations that illustrated how correct commands should look helped experienced and novice computer users determine exactly how to implement a procedure. A possible reason why the syntax examples facilitated performance, to the exclusion of the concept elaborations, is that perhaps the syntax examples more closely matched what the subject needed to do.

Consistent with this point of view, in their study to teach writing recursive functions, Pirolli and J. R. Anderson (1985) found that the subjects whose text included examples and explanations of correct syntax performed more efficiently. They suggested that it is the example, which is used to illustrate how to do the task rather than to simply clarify what happens during a skill learning procedure, helps performance. Their protocol data indicated that subjects do rely heavily on examples to guide their solutions to novel and difficult problems. Ross (1984) has shown that performance in a domain of new skill learning is affected by prior examples when these examples match on superficial features. Pepper (1981) reported the surprising findings that the subjects overwhelmingly preferred a verbose and poorly written text (conversational-style) over a concise and well written one (outline-style) because they attempted to look for explanations and examples for help. In a sense, one indicator of good text is the degree to which writers elaborate on a topic with explanations, supporting ideas, and examples (Benton & Blohm, 1986). Pepper (1981) claimed that a technical text, such as a computer documentation, will be more readable and more effective by avoiding technical jargon, writing in a clear and unpretentious style, and incorporating various graphical and textual aids into the body of the text. Thus, a new experimental chapter was written by Pepper according to his guidelines (see Pepper, 1981, p. 263 for a review), and the results showed that the subjects who read the new chapter performed substantially better in their comprehension, and rated the new chapter more favorable than any of the others. Two conclusions that Pepper (1981) suggested for the field of document design are: (1) examples should be used as a tool for bridging the gap between the expert and the novice; and (2) textbooks should be written for the student, at the student's level, and with the active guidance of the student.

Summing up the findings of previous research, text-based elaborations facilitate in the domain of declarative fact learning and skill performance. To some degree, a useful and important form of elaboration is the example, particularly for helping people learn a procedure. However, several studies have noted that not all types of examples provide the same help. Examples that were found to facilitate performance are those that address syntactic information, and those that clarify how to execute commands in computer-related procedures. For the sake of learners' needs in a procedure learning, providing concrete examples of "how to do" rather than giving concept elaborations dealing with "what they are" can reduce initial learning time. In addition, increasing elaborations in the forms of graphical aids, textual aids, examples, and explanations is effective and preferred by students while learning a computer-related skill.

However, findings on the role of text-based elaborations in learning a procedure are inconsistent. Although the studies previously described indicate that text-based elaboration facilitates learning a procedure from text, other studies provide evidence that unelaborated texts are better for adult learners who are learning new procedures. For instance, some studies in the computer-related domain indicate that text-based elaborations facilitate learning declarative information when the performance measure is either free recall or recall of the main points of the text (Reder, Charney, & Morgan, 1986; Pirolli & Anderson, 1985; Pepper, 1981; Mayer, 1980). In contrast, Carroll (1984, 1990) argues that self-learning procedures from text are more efficient when the text contains no elaboration, or at least very few elaborations, and his findings from several studies have indeed shown an advantage for learning procedures from unelaborated text.

Training

During the 1980's, the problem of training users in the use of computer programs has been the focus of considerable research. Carroll and colleagues (1984, 1987-88) at IBM pointed out several problems that novice computer users had while learning a word processing program. They found novice learners are apt to:

- Be overwhelmed by learning tasks;
- "Jump the gun" to act instead of reading explicit warnings or suggestions;
- Skip the information that cannot be executed;
- Trust their own reason to act instead of reading the instruction;
- Sometimes ignore the screen when following a tutorial step-by-step;
- Have trouble recovering from errors;
- Want to do real work right away and understand "why" and "what" they are doing.

Minimalist Approach. Most computer learners do not want to read through a thick manual or work through an on-line tutorial if they are not interested primarily in the to-be-learned program or system. Impressed by the frustration and failure the trainers observed when novices attempted to learn to use commercial word processing systems by means of the commercial self-study books that accompany them, Carroll et al. (1984) developed and tested the Minimalist Training Model, a model that accommodates and capitalizes on user learning styles and strategies. This is what Carroll called the *Minimalist Approach* which attempts to support active learning by providing concise instruction focused on easy-to-understand goals. According to Carroll, "the key idea in the minimalist approach is to present the smallest possible obstacle to the learner's efforts" (Carroll, 1990, p.77) to learn and acquire competency.

In an earlier set of studies, Carroll et al. (1984, 1985) created the "Minimal Manual" that incorporates elements of the Guided Exploration approach (Carroll, 1984), in order to meet the needs of computer learners in learning a word processing system with "training wheels." By training wheels, Carroll provided new users with a real but easier system with regard to learning to recognize and avoid errors. The training wheels subjects were better able to transfer their skills to perform advanced full-system editing functions and spent less time in error recovery than full system subjects.

Carroll (1984, p.130) outlined five premises for developing computer documentation according to the Minimalist model:

- "slash the verbiage" by eliminating all repetition, summaries, reviews, practice exercises, the index, and the troubleshooting appendix;
- to force coordination of the system and the training;
- to expect every possible error;
- to focus on real tasks and activities; and
- to support error recognition and recovery.

After a series of studies, Carroll et al. (1984, 1985, 1987-88) found that minimal manuals do help learners better coordinate their attention between the system and the manual, better recognize and recover from errors, and better support reference use after training.

Carroll et al.(1984, 1985) advocated a Guided Exploration approach to provide learners with brief training materials that encourage and support learning by exploration. Guided Exploration, based on the principle of Minimal Manual, is a set of brief cards that replace a commercial self-instruction manual. In helping people to use a word processor, Carroll et al. found that brief "guided exploration" cards are more effective than a commercial manual in many respects. Subjects using the cards accomplished more tasks, made fewer errors, spent less time reading and doing the tasks, and recovered more often from errors. Brief guided exploration materials focus users on the steps needed to accomplish basic tasks by encouraging and supporting exploration through easy-to-find procedural information and timely error recognition and recovery advice (Catrambone and Carroll, 1987, p. 170) Recently, Duin (1990) designed a study that investigated the effects of a minimal manual version versus a guided exploration card version of documentation for learning to use a telecommunication system. The results showed that both forms of documentation--the minimal manual and the guided exploration card-- are viable forms for the design and development of computer-related documentation because they both center on the learner by seeking to delete extraneous text. Duin also suggested that while designing documentation, designers should (1) center on functions rather than concepts, (2) think in terms of tasks rather than terms, and (3) develop syntactic rather than conceptual elaborations.

Effective computer documentation should not only allow learners to understand how to perform specific tasks, but should also allow them to create, explore, and integrate knowledge when they use a computer program in the system. While computer programs as a whole are improving, the documentation that accompanies the programs, should improve along with it to better meet learners' needs. Toward this end, we might re-introduce the structure of a manual based on learners' needs by codifying some of the principles which were helpful to the guided exploration learners. Summing up the results of a series of studies, Carroll (1990) concluded and developed the following nine principles of the minimalist approach (see p. 78-93 for a review):

1. Training on real tasks--allow the user select meaningful tasks to work on.
2. Getting started fast--urge getting learners started doing tasks as quickly as possible.
3. Reasoning and improvising--permit self-directed reasoning and improvising in learning process to enrich their own training experience.
4. Reading in any order--eliminate sequence and design materials allowed learners to read and use in any order.
5. Coordination system and training--impel the learners to attend the system during the course of training.
6. Supporting error recognition and recovery--support the recognition of and recovery from errors so that errors will not block the learners.
7. Exploiting prior knowledge--concrete schemes from learner's prior knowledge may motivate and facilitate learning and skill development.
8. Using the situation--let the situation occur naturally rather than protect the learners from experiencing difficulties or errors.
9. Developing optimal training designs--minimize instructional materials that obstruct learning and design the materials to support learner-directed activity and accomplishment.

According to the principle of the minimalist approach, the role of elaboration that Carroll emphasizes is learner-generated elaboration against author-provided elaboration. He encourages learners to engage in active self-elaboration (prompted by incomplete materials for learning, such as summaries from the full text) in order to make information more robust and accessible in memory (Carroll 1990, p. 81). It appears that a main reason the performance in the minimal manual is superior to the commercial self-instruction manual is that it forces learners to make inferences. Actually, Black, Carroll, and McGuigan (1987) found that the Inferential version of the Minimal Instruction Manual yielded better learning than did the Skeletal, the Rehearsal and the Lengthy versions. In particular, they noted that the Lengthy Manual consistently yielded worse performance than the other versions. Thus, continuing research is investigating how different types of inference, such as analogy, proceduralization, and instantiation, affect learning.

In addition, Carroll (1984) stated that "forget the preview and review; studies indicate users can learn more, given less information" (p.125). He strongly recommends eliminating orientational material, including introduction, overview, preview, review, and conceptual elaborations because they obstruct the learner's desire to do something instead of reading about how to do something. He continues, "the minimalist approach urges getting learners started doing projects as quickly as possible, allowing meaningful and concrete activity to provide intrinsic learning guidance--rather than relying on the extrinsic guidance of conceptual elaboration and practice with numbered steps, techniques that too often become obstacles to learning" (Carroll, 1990, p.81). That is, the Minimalist design presumes that if you give the learner *less* (less to read, less overhead, less to get tangled in), the learner will achieve *more*.

However, a truly minimalist approach--with no previews, with no explanations or elaborations--may not be best in all situations. For example, Reder, Charney, and Morgan (1986) found the evidence that performance in the elaboration-after condition was significantly better than performance in the unelaborated-after condition, where no source of elaborations was available. But in the same study, they also indicated that when subjects already knew what tasks they would perform, they benefited very little from seeing examples and other elaborations in the text. By contrast, Charney and Reder (1987) provided the value of preview that learners who were given a problem first, asked to try to solve it, and shown a solution at the end, learned best.

Therefore, despite its brevity, Wendt (1991) argued that the Minimal Manual (Carroll, 1990) should not be thought of as simply an unelaborated version of the original text for several reasons: (1) information was eliminated that was not task-oriented(e.g., descriptions of the system); (2) information was added to address error recognition and recovery procedures; (3) information was rearranged to support topics of interest to learners; and (4) sometimes procedural details were deliberately specified incompletely or introduced with an invitation to try them and see what would happen.

In conclusion, the effects of minimalist approach cannot separate from the effects of the guided exploration (discovery) approach as well as the emphasis on error recognition and recovery. Nevertheless, using a minimalist approach, people learning a procedure from text are able to acquire competence and perform well on transfer tasks without benefit of many author-provided elaborations. Besides author-provided elaborations, the minimalist approach allows learners to generate their own elaborations during the learning process. That is, author-provided elaborations may facilitate skill learning in some situations, but not others. Therefore, for developing an effective text, it is very important to establish guidelines for determining what types of elaborations are optimal in what situations and when to use them in order to facilitate fact or skill learning.

Minimalist vs Maximalist Approach. To answer the question whether computer manuals should be minimalist and contain only information that is absolutely necessary, or should be maximalist and fully explain unfamiliar concepts and procedures, Wendt (1991) directly compared three versions of texts in order to examine the effects of an original version, as well as an Elaborated and an Unelaborated revisions of an excerpt from a commercial system user's manual on the self-learning procedures from text. First, she summarized the issues that support an extensively elaborated text and those that support a minimally elaborated self-instructional text, and then provided contrasting guidelines for developing an effective text (Wendt 1991, p.36).

The guidelines for supporting an extensively elaborated text to produce an effective, readable text for the learners (at least in the short run) are the following:

- Use concrete examples to support every major and most minor points.
- Use graphical aids such as illustrations and diagrams.
- Use textual aids such as introductions, summaries, and.glossaries.
- Use explanations for all definitions, technical terms, solution rules, and procedures.
- Use syntactic elaboration instead of conceptual elaboration to clarify how to perform the to-be-learned procedures.

Guidelines for supporting a minimally elaborated text to help learners get started faster, perform better, make fewer errors, and recover from errors more successfully, are the following:

- Do not embed examples which may be obstructive for the learners.
- Do not include explanations but urge the learners to discover their own.
- Do not provide materials that give the learners a model of correctness; but encourage exploration and support error recovery.
- Do not increase text by adding elaboration but reduce text by eliminating elaboration and instruction for the purpose of requiring the learners to make inferences from the incompletely remaining text.

Wendt (1991) offered a new perspective for evaluating the role of text-based elaboration in the process of self-learning a new procedure by directly comparing the effects of these two approaches on learning the same procedure and performing the same tasks in one study.

According to the guidelines mentioned above, the Elaborated version in Wendt's study included changes, such as (1) reorganizing the content by separating conceptual and procedural information; (2)

adding elaboration in the form of examples, restatements, explanations, an introduction, a summary; (3) adding text-to-graphic references to support both conceptual information and procedural information, (4) adding several examples of using different combinations of connectors to link selection rules; and (5) removing side-margin subheadings. By following the principles of designing minimalist instructions, changes in the Unelaborated version included (1) identifying statements of procedures and rules; (2) deleting all elaboration such as examples, restatements, and descriptions of what the software does as a result of procedures; (3) deleting unnecessary words; (4) deleting introductory text; and (5) deleting side-margin subheadings (Wendt, 1991).

Changes from the Original User's Manual in Wendt's Study

Elaborated Text version	Unelaborated Text version
(1) reorganizing the content by separating conceptual and procedural information	(1) identifying statements of procedures and rules
(2) **adding elaboration**-- • examples • restatements • explanations • an introduction • a summary	(2) **deleting all elaboration**-- • examples • restatements (actually included three) • explanations • descriptions of what a procedure goes • an introduction • a summary
(3) adding text-to-graphic references to support both conceptual information and procedural information	(3) deleting unnecessary words
(4) adding several examples of using different combinations of connectors to link selection rules	(4) deleting introductory text
(5) removing side-margin subheadings	(5) deleting side-margin subheadings

Consistent with the idea that text-based elaborations facilitate learning declarative information when the performance measure is either free recall or recall of the main points of the text, Wendt indicated in her study that the performance of the Elaborated text on the given tasks was equal or superior to the Original text and the Unelaborated text versions. She found that those who read the Elaborated text achieved a higher percentage of elements correct, more correct solutions, committed fewer errors, did not spend significantly more time reading their text but spent less time working on the application tasks, and rated their text more positively and more consistently. She also indicated that the subjects who studied the Elaborated text continued to perform well as task difficulty increased because the Elaborated text in her design separated conceptual and procedural information and elaborated both types of information that served an important factor in facilitating their understanding. However, she reported that not all subjects who read the Elaborated text performed well. In other words, not all people need elaboration to develop a good understanding in a procedure learning.

While Wendt wanted her subjects to read the instructional text first and then complete the application tasks 'without' the text, however, it belongs to an immediate posttest to test subjects' memory for information acquired via text after study. It occurred to me, that in a real world setting, learners may not need recall text from their memory in order to learn a new computer program. On the one hand, Carroll (1984) argued that if learners go along nose-in-the-book, they will not learn to use the system (p.126). On the other hand, focusing on the learner's primary goal to complete a specific task, learners want to attempt tasks immediately rather than read and remember information for future recall. Therefore, the idea of coordination of the system and the training at the same time should be concerned for further studies.

The Current Study

The purpose of study in this paper is to investigate the effects of augmenting and deleting elaborations in an existing self-instructional text from a computer automated database file. The intent here is to replicate and extend Wendt's (1991) study by asking students to read one of the three self-instructional texts and complete several given tasks accompanied with the copy of materials in the same period of time instead of an immediate posttest. To increase the power of the analysis, the present study increases the sample size from 21 to 60. The study attempts to discover whether students who learned to use a computer database program from an elaborated text did better than students who learned from an unelaborated one.

Learner-generated elaborations were not included in the texts, since it is too difficult to control for differences in learner's prior knowledge. The present study will exclude all types of learner-generated elaborations in favor of author-provided elaborations. The types of elaborations provided by the experienced author in the study are those directly included in the material to-be-learned for the purpose of facilitating a more complete and accurate understanding of the material itself, and appropriate application to individual tasks. Specially, the research questions asked here are: (1) will author-provided elaborations facilitate the learners' performance on given tasks in a self-learning procedure from text? (2) will the elaborated text be more effective than the unelaborated text during the self-learning procedure? (3) will the amount of text-based elaboration differentially affect performance on the given tasks while the difficulty of the tasks increases?

Method

The present study sought to extend the previous investigation by Wendt (1991) to examine whether students who learn from an elaborated text do better on performance of a computer database application than students who learn from an unelaborated text. A purpose of this study was to replicate previous findings reported by Wendt (1991), so the materials used here are similar, with the exception of the number of the subjects and the way of the procedures.

Subjects

Sixty undergraduate students from the Department of Psychology at the University of Minnesota completed the study. Students received research participation points as well as five dollars for participating. The subjects varied widely in their prior general experience with computers; however, they had no prior experience with the Microsoft Works Database application.

Materials

The database. Subjects used a database file of 25 records created in the Microsoft Works Database program in conjunction with the six application tasks Although all 25 records contained the same 15 fields, data in each field were different from one record to another. The contents of the 15 fields within each record, including name, title, company, and desired sessions, consisted of fictitious information from a registration form requested for a training workshop.

The Original text. The text was adapted from the Microsoft Works User's Manual (1989), an instructional text provided for the learners to use and apply the computer software--Microsoft Works. In this study, the six pages that explain how to use the *Selection Rules* to locate and retrieve desired information from the database file were excerpted from the User's Manual. Two versions were created from the Original Text by Wendt (1991) according to the guidelines she set (discussed in the previous section). One was an Elaborated Text version that was developed using the guidelines for an extensive Elaboration approach. The other was an Unelaborated Text version developed using the guidelines for designing minimalist instructions.

Elaborated text version. The Elaborated Text version was extended to twenty-two pages long. According to the guidelines established by Wendt (1991), the Elaborated Text version was developed from the Original Text in three steps:

First, the content from the Original Text was analyzed and outlined. There were four major areas identified: (1) deciding selection rules; (2) entering selection rules; (3) connecting selection rules; and (4) making changes.

Second, a terminal performance objective was identified and a learning hierarchy was constructed. Since the terminal performance objective in the learning procedure was to retrieve records from a database file by using selection rules, a learning hierarchy that showed the prerequisite relationships among the skills to-be-learned played an important role. As a result, the Elaborated Text version was constructed with the following components: (1) an introduction; (2) how to create a single selection rule; (3) how to enter a single selection rule; (4) how to use combinations of selection rules; (5) how to enter multiple selection rules, (6) how to make changes; and (7) a summary.

Third, syntactic elaborations (rather than conceptual elaborations) were created and extensive elaborations were provided to support the explanations of procedures (such as how to create a single

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selection rule and how to link selection rules using connectors). The most frequently used type of elaboration was examples (e.g., create the pairs of correct and incorrect examples in terms of supplementing the explanation of why the incorrect examples were not right).

There were some elaborations that provided additional content which dealt with how to use the connectors in these ways. To begin with, some examples were given to explain the use of connector "And." Then, some examples were given to explain the use of connector "Or." Finally, several examples using a combination of the two connectors were given and explained.

Unelaborated text version. The Unelaborated Text version was six pages long. Working from the Original Text, this version was created according to the principles of designing minimalist instructions: (1) identify statements of procedures and rules; (2)delete all elaborations including examples, restatements, explanations, and descriptions of what a procedure goes; (3) delete introductory text; (4) delete unnecessary words; and (5) delete side margin subheadings.

As a result, 114 lines of text in the Original Text were reduced to 75 lines of text. However, the format of the original text was maintained in the Unelaborated Text version. After a pilot study, the Unelaborated Text was revised by adding three restatements (1) to explain the definition of "record comparison information"; (2) a step in the procedure for entering a selection rule on the computer screen; and (3) how the connectors interacted when they were used together. In spite of these additions, it was consistent with the principle of minimalist approach advocated by Carroll (1990), including error recognition and recovery procedures.

A comparison of frequencies of different types of elaboration across the three different types of texts is listed in the following table. Three illustrations that provided important navigation information were included in all three versions .

Comparison of Frequencies of Different Types of Elaboration

Types of Elaborations	Original Text (6 pages)	Elaborated Text (22 pages)	Unelaborated Text (6 pages)
Boldface Types	2 items	all items	all items
Italics	yes	yes, with some single and double underline	yes, with only 1 single underline
Graphical Illustrations	3	3	3
Textual Examples	6	31	0
Marginal Comments	6	0	0
Paraphrases and Restatements	0	10	3
Headings	4	7	5
Summaries	0	1	0
Overviews	1	7	5
Intertextual References	1	1	1
Text-to-Graphic References	2	18	3

Background information and prior experience questionnaire. This questionnaire contained six questions asking the participants to provide (1) academic major, (2) year in school, (3) status (full or part-time student), (4) prior experience with computer hardware,(5) prior experience with computer software for what purpose, and (6) prior experience with the Microsoft Works database application.

Background information about these materials preface. A three-page supplement to the text was created to demonstrate what a database is, how it works, and to explain the contents of the database file that would be used in the study. The same three-page supplement was placed directly above each text and marked as pages 1, 2 and 3. Initially, page 1 established a context both for the reading of text and the given application tasks in order to provide a general overview of this study. Page 2 explained how information is organized in a database file, and provided an example for subjects to distinguish two key terms: records and fields. Page 3 listed the 15 fields with their definitions. Therefore, the text that described the use of selection rules always started on page 4.

Application tasks. There were six application tasks designed to test subjects' understanding of the information, procedures provided in the text, and their ability to apply the information in the computer setting. For example, task 1 asked: "Who is coming from IBM?" which required subjects to retrieve the records of the persons who were coming from IBM. Since IBM belongs to a "company" (its corresponding *field*), subjects should have selected "company" from the *field* first, chosen "equals to" from the *comparison phrases*, and then typed "IBM" in the box of *record comparison information*. This task was the simplest one, which used only one selection rule without any logical connectors. Task 2 asked: "Which companies are sending either the President or the CEO?" which required retrieving the records of companies that were sending the persons whose title was either President or CEO. Since the box for *record comparison information* can only hold one instruction at a time, subjects were required to use a *logical connector* "Or" to link the person whose "title" "equals to" "President" and whose "title" "equals to" "CEO". Therefore, two selection rules were used in this task.

The difficulty level of the tasks on the list increased by (1) increasing the number of selection rules required to complete a task; and (2) increasing the correct use of logical connectors to combine the selection rules. The following table (adapted from Wendt 1991, p.48) shows the increase in difficulty by task. To clarify, when rules are linked with a combination of 'And' and 'Or', the program will locate only those records that satisfy all the Selection Rules continuously linked by 'And'. When it sees the Connector 'Or', it will begin a new and separate search for these records.

Dimensions of Difficulty in the Application Tasks

Task Number	Selection Rules	Logical Connectors
1	1	0
2	2	1 - Or
3	3	2 - And, And
4	4	3 - And, Or, And
5	5	4 - And, Or, And, And
6	6	5 - And, And, And, And, And

Attitude survey. The attitude survey was composed of six questions. Responses were recorded by subjects using a six-point scale. Four of the questions used by Pepper (1981) were adapted in order to compare the results. These four questions asked the subjects (1) how easy the text was to understand, (2) how well the material was "taught" by the text, (3) how well reader's questions were answered, and (4) asked for an "overall" rating. In addition, two questions were added to obtain feedback on the examples and text-to-graphic illustrations, since many of them were added to the Elaborated Text version.

Design

This study involved a single independent variable with three levels: *Original Text version*, *Elaborated Text version* and *Unelaborated Text version*. The dependent measures within the study were (1) percentage scores of elements correct on each of six application tasks, (2) number of correct solutions across all application tasks, (3) total time spent on reading the text and working with the application tasks, and (4) results on an attitude survey. The results of each of the six performance tasks were analyzed in a repeated measures fashion with one between-subjects factor ("Version" with three levels) and one within-subjects factor ("Task" with six levels). One-way ANOVAs were used to analyze the results for each of the other measures, with Version as the independent variable. Results of mean scores across the three versions from attitude survey were also analyzed with one-way ANOVA and presented in simple descriptive format.

Procedures

The study was conducted individually in one session approximately 60 - 90 minutes in length. Sixty copies of materials, including 20 of the Original Text, 20 of the Elaborated Text, and 20 of the Unelaborated Text versions, were prepared prior to the study and placed in unmarked, brown envelopes. To achieve random distribution, all envelopes were repeatedly shuffled so that subjects studied one text in each of the three conditions: Original, Elaborated or Unelaborated Text version.

After completing a Consent Form, a Background Information Questionnaire, and an Experience Questionnaire, each participant was asked to read the first three pages of materials (that provided information about what a database is and how to perform the procedures in the study). No time limitation was imposed as subjects familiarized themselves with the content of these three pages. When a subjects was ready, a list of tasks was given and he/she was directed to read either an Original, an Elaborated or an Unelaborated instructional text of Microsoft Works Database application, and to complete the six given tasks within an hour. The instructional texts were available at the same time that the subjects were completing the tasks. Subjects were allowed to mark or underline the text while reading if they so desired, but they could not ask any questions. When the hour was up, subjects were told to stop working, whether they completed all the application tasks or not. Subjects could stop at any time during the session if they finished the tasks earlier. Then, the six-item attitude survey was given. Participants were asked to rate each question with "1" being the most negative reaction and "6" being the most positive reaction. Finally, each subject received research participation points, as well as five dollars, for participating,. Subjects were also given a copy of the Education Debriefing Form that briefly summarized the rationale of this research on the role of elaboration, and provided references and additional sources of information on this research topic.

Results

Mean Percentage of Elements Correct on Each Application Task

Table 1 presents the mean percentage of elements correct for each text version and application task. Results of a repeated measures ANOVA using Versions (Original, Elaborated, and Unelaborated) as the between-subjects factor and Task (1 to 6) as the within-subjects factor was shown in Table 2 as follows: the between-subjects factor of Version was not significant [F(2, 57) = .36, p = .701, MS_e = 2597.28]; the within-subjects factor of Task was significant [F(5, 285) = 22.22, p < .001, MS_e = 421.05], while the Version by Task interaction effect was not [F(10, 285) = .90, p = .530 , MS_e = 421.05].

Table 1: Mean Percent of Elements Correct for Each Version and Task

Text Version	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task Mean
Original (n=20)	100%	91.45%	85.45%	66.60%	70.80%	60.75%	78.800%
Elaborated (n=20)	100%	91.45%	77.30%	72.95%	82.45%	72.10%	82.708%
Unelaborated (n=20)	95.05%	87.15%	73.60%	63.30%	77.15%	67.10%	78.342%
Total Mean (n=60)	98.35%	90.02%	78.78%	67.62%	76.80%	66.65%	79.703%

Table 2: Analysis of Variance for Percentage of Elements Correct

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	P
Between Subjects					
Version	1854.16	2	927.08	.36	.701
Subjects Within Groups	148044.88	57	2597.28		
Within Subjects					
Task	46788.95	5	9357.79	22.22	.000*
Version x Task	3806.74	10	380.67	.90	.530
Task x Subjects Within Groups	120000.48	285	421.05		

A follow-up series of t-tests was run pairwise across the six tasks. A Bonferroni procedure was used to control Type I error resulting in alpha = .01. Results of the follow-up t-tests to the "Task" repeated measures effect are shown in Table 3. To summarize Table 3, there were significant difference between Task 1 and Tasks 2, 3, 4, 5, and 6; similarly, Task 2 was different from Tasks 3, 4, 5, and 6. Moreover, Task 4 was significantly different from Tasks 3 and 5.

Table 3: Pairwise t-tests (df = 59) Among the Six Tasks
(alpha = .01, using Bonferroni adjustment)

			Task		
Task	2	3	4	5	6
1	t = 4.11 p = .000*	t = 5.68 p = .000*	t = 8.97 p = .000*	t = 5.80 p = .000*	t = 6.63 p = .000*
2		t = 3.28 p = .002*	t = 6.88 p = .000*	t = 4.06 p = .000*	t = 5.71 p = .000*
3			t = 3.29 p = .002*	t = .54 p = .594	t = 2.44 p = .018
4				t = -2.85 p = .006*	t = .22 p = .824
5					t = 2.47 p = .016

Number of Correct Solutions

"Number of Correct Solutions" means the number of subjects who achieved 100% elements correct for each task in each text version group. Table 4 shows the number of correct solutions for each version and task. However, there was no difference between tasks in terms of the total number of correct solutions [F(2,57) = .573, p = .567, MS_e = 3.227].

Table 4: Number of Correct Solutions for Each Version and Task

Text Version	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Total
Original (n=20)	20	15	14	5	7	9	70
Elaborated (n=20)	20	14	10	6	8	13	71
Unelaborated (n=20)	17	12	9	4	9	9	60

Total Time Spent Reading and Working on Tasks

Table 5 presents the mean time spent for each text version group. The result shows no differences for total time on reading and working the tasks among the three Text Versions [$F = .175$, $p = .840$, $MS_e = 125.507$].

Table 5: Mean Time Spent Reading and Working on Tasks

Text Version	Time
Original	46.15 min.
Elaborated	48.15 min.
Unelaborated	46.60 min.

Attitude Survey

Table 6 presents the results of the attitude survey ("1" was the least favorable reaction and "6" was the most positive reaction). The data seems to indicate that not all subjects needed examples or illustrations for help among the three conditions. Although on average subjects in all three groups rated the texts in a positive way, the ANOVA on mean attitude score across the three versions was non-significant [$F(2, 57) = .224$, $p = .800$, $MS_e = 1.024$]. No differences are on each question among the three versions, either.

Table 6: Ratings of the Three Text Versions

Questions of Attitude Survey	Text Version **Original** Mean	 Range	 **Elaborated** Mean	 Range	 **Unelaborated** Mean	 Range
1. Easy to Understand	3.65	1-6	3.85	2-6	3.55	1-5
2. Taught Material Well	4.10	2-6	4.10	2-6	3.85	1-6
3. Answered Questions	3.65	1-6	3.95	2-6	3.85	1-6
4. Illustrations Helpful	4.05	1-6	4.15	2-6	4.35	3-6
5. Examples Helpful	4.05	1-6	4.20	2-6	3.75	2-6
6. Overall	3.90	2-6	4.15	2-6	3.85	1-6
Group Mean of Attitude	**3.90**		**4.07**		**3.87**	

Discussion

The present study examined the effect of varying degrees of text elaborations on self-directed student learning, to learn to use a computer database application. Using guidelines from Wendt's (1991) study, an Elaborated Text and an Unelaborated Text were developed from an original commercial system user's manual. Subjects completed six applied tasks by reading one of the three instructional text versions, and completed an attitude survey at the end.

The results of the current study not only deviate from Wendt's findings (which supported the effects of elaboration on self-directed learning from text), but also differ from Carroll's approach, which suggests the minimalist manual's superiority to the commercial self-instruction manual. The effects of task in a 3(Version) x 6(Task) repeated-measures ANOVA was significant, while both the Version and the Version x Task interaction were not. No differences among conditions were found for treatment with the following dependent variables: (a) percentage of elements correct on each of six performance tasks, (b) number of correct solutions across all performance tasks, (c) total time spent reading and working on the application tasks, and (d) results on attitude survey. It seems that the advantages of elaborations on computer documentation do not produce the same effect when subjects can complete the application tasks accompanied by the instructional text. That is, unlike Wendt's results, subjects who read manuals containing extensive elaborations in the present study did not out-perform subjects who read manuals with less elaboration. And, unlike Caroll's findings (1984, 1985, 1987-88, 1990), subjects who read the unelaborated manual did not perform better than subjects who read the longer, elaborated manual.

A possible reason for the differences in results reported by Wendt (1991) is that the present study involved simultaneously completing the tasks and reading the text in order to simulate goal-oriented learning in a real-world setting. Subjects in the current study attempted the application tasks accompanied by the text instead of reading the text first and then working on the tasks without using reading materials. This was done to maximize the external validity of the study, because few people learn to navigate a new computer program by memorizing an instructional text. In Wendt's study, results focused on the effectiveness of elaborations on recall and retrieval of the main points of the text. In the current study, the investigation focused on whether text-based elaborations facilitate procedural learning while learning a new computer program in a real-world setting.

An analysis of subjects' performance on the easier versus the more difficult tasks gives additional information. The six application tasks were created based on a learning hierarchy for the procedural learning, and most subjects correctly completed the easiest task, which required the use of only one single selection rule. As task difficulty increased, subjects were required to construct and input more rules, as well as combine those rules by using the correct connectors.

Results show that each of the six tasks seemed successively more difficult, but Task 4 appeared the most difficult. The reason for this might be not attributed to subjects' understanding of the logical concepts of the connectors 'And' and 'Or', rather than how to select and input the rules. Task 4 asked "Who is coming from Texas and California that is attending the Session on Topic C?" It required retrieving the records of the persons who come from the states of either the Texas or California, but they should attending Topic C. Many subjects used the following rules:

the persons whose "state" "equals to" "Texas"
'Or' "state" "equals to" "California",
'And' "attending Topic C" "equals to" "yes".

Using these rules, the answer obtained shows the persons who come from Texas but not attending the session on Topic C, because the connector 'And' only linked with the last two rules: "state equals to California" and "attending Topic C". The correct rules are the following:

the persons whose "state" "equals to" "Texas"
'And' "attending Topic C" "equals to" "yes".
'Or' "state" "equals to" "California",
'And' "attending Topic C" "equals to" "yes".

Four selection rules with three connectors should have been used in this task.

There were six examples given in the Elaborated text, three examples in the Original Text, and none in the Unelaborated text. The investigator expected that the subjects using the Elaborated text would perform better because more examples were provided that supported the solution. As a result, subjects who read the Elaborated Text version scored 72.95% of elements correct in Task 4, compared with a score of 66.60% of elements correct for subjects who read the Original Text version and 63.30% of elements correct for subjects who read the Unelaborated Text version. However, these differences were not statistically significant. When looking at the number of correct solutions on the same task, only 6 out of 20 subjects got every item correct in the Elaborated Text group, only 5 of them got every item correct in the Original Text group, and 4 of them got every item correct in the Unelaborated group. The performance on Task 4 was poor across all three conditions. This finding did not support the view that using examples is an important tool for bridging the gap between the expert and the novice.

Regarding the number correct across the three conditions, the Elaborated and Original Texts produced fairly similar performances, but performance wasn't significantly better than those in the Unelaborated Text condition. In addition, when looking at the total time subjects spent reading and working on the tasks, the investigator assumed that subjects who studied the 22-page Elaborated Text would spend more time reading than those who had the Unelaborated Text and the 6-page Original Text. The results show that subjects who had the Elaborated Text spent, on average, only 1-1/2 to 2 minutes more time reading than subjects who had the Unelaborated Text and the Original Text. However, comparing the combined times of reading and working on tasks for each group in Wendt's study, on average, subjects in the Original Text group spent the most total time (58.13 min.), while subjects in the Unelaborated Text group spent the least total time (37.22 min.) and subjects in the Elaborated Text group spent the second least total time (41.57 min.). Wendt reported that as compared to those who read the other text versions, those who read the Elaborated Text performed better than the other versions but did not spend significantly more time reading their text (26.57 min. while 28.28 min. in the Original group) and spent less time (15.00 min.) working on the application tasks (when 20.57 min. in Unelaborated group and 29.85 min. in the Original group). To compare the learning efficiency of the performance among the three groups in the current study, the data, calculated from the mean percentage of elements correct for tasks of each subject divided by the total time he or she spent, shows that, on average, the Original Text group achieved 1.98% elements correct per minute, while the Elaborated Text group achieved 1.80%, and the Unelaborated Text group achieved 1.83% elements correct per minute. The result, differs from Wendt's, indicates that people who read the elaborated text did not demonstrate better learning efficiency.

Subjects' overall ratings of the Text on the attitude survey showed no differences among the three versions. However, subjects who read the Elaborated Text rated a positive score of 4.20 to '*examples helpful*' on a 6.00 scale, but this was not statistically significant. This result suggests that not all examples facilitate procedural learning. On the other hand, subjects who read the Unelaborated Text rated a positive score of 4.35 to '*illustrations helpful*' on a 6.00 scale, but this was not of higher statistical significance than subjects who read the other text versions (even though all the three text versions had the same illustrations). It is interesting to note that examples may not always be necessary because when subjects cannot locate relevant examples, they tend to use rules from the illustrations. That is, examples and illustrations of elaborations may be helpful in some situations, but not all. Moreover, the wide spread in Attitude ratings of the three text versions indicate that both Elaborated and Unelaborated Text versions have room for improvement Since attitude ratings indicated that there were positive and negative aspects of the texts, it would be useful to identify these features and create new texts that more adequately address learner needs.

Conclusion

In conclusion, the absence of a significant difference in the task performance across the three text versions suggests that not all people require elaborations to develop a good understanding of procedural learning. A possible reason for this finding is that the advanced use of logical connectors became too complex for some subjects since all groups had a consistently low performance on Task 4. Alternatively, some of the tasks might have been so simple that they did not require elaboration. This assertion is supported by the finding that subjects who read the Unelaborated Text without any examples did not perform worse than other groups.

The absence of differences across the three versions may also be affected by the fact that all subjects were college students. Generally speaking, younger subjects may need more elaborations than adults because, in the absence of elaborations, adults may try to find other ways to solve their problems. In addition, it's possible that, in general, adults may have had more computer experience than children. According to the background information provided by subjects for this study, at least 90% of them had some experience with other computer software applications (which may have used similar navigational tools). Obviously, the more prior computer experience individuals have, the easier it is for them to navigate throughout a new computer application. Therefore, conducting further research with younger subjects and/or individuals with less computer experience may produce different results on the effect of the elaborations.

It would also be useful to conduct a study in which additional versions of the text were created in order to isolate specific types of changes. For example, it would be interesting to add a combination version of the use of elaborations with more examples and the use of a minimal approach with less statements to see what kinds of instructional text would successfully facilitate skill learning. Another idea for a future study was suggested by Redish in 1987. She suggested that on-line tutorials that display instructional texts directly on the computer screen would be a fascinating area for research on a document that combines aspects of reading to learn and reading to do. Moreover, additional questions could be added to the Attitude Survey and the responses used to improve the texts.

It would also be interesting to conduct a study in which an additional posttest or delayed posttest was administered to examine the effects of elaborations on transferring a skill. Additional factors (such as age) should be considered while designing a new study. It would be useful to determine which features of the extensive elaboration approach and the minimalist approach work best for different types of users, different types of computer programs, and different types of procedural learning.

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